# Minerals Yearbook

# 1984

## *Volume II*

## AREA REPORTS: DOMESTIC

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

*Prepared by staff of the*

BUREAU OF MINES

**UNITED STATES DEPARTMENT OF THE INTERIOR • Donald Paul Hodel, Secretary**

**BUREAU OF MINES • Robert C. Horton, Director**

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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# Foreword

This edition of the Minerals Yearbook discusses the performance of the worldwide minerals industry during 1984 and provides background information to assist in interpreting developments during the year being reviewed. Content of the individual volumes follows:

Volume I, Metals and Minerals, contains chapters on virtually all metallic and nonmetallic mineral commodities important to the U.S. economy. In addition, it includes a statistical summary chapter, a chapter on mining and quarrying trends, and a chapter discussing the statistical surveying methods used by the Bureau of Mines.

Volume II, Area Reports: Domestic, contains chapters on the mineral industry of each of the 50 States, the U.S. island possessions in the Pacific Ocean and the Caribbean Sea, and the Commonwealth of Puerto Rico. This volume also has a statistical summary.

Volume III, Area Reports: International, contains the latest available mineral data on more than 130 foreign countries and discusses the importance of minerals to the economies of these nations. A separate chapter reviews the international minerals industry in general and its relationship to the world economy.

The Bureau of Mines continually strives to improve the value of its publications to users. Therefore, constructive comments and suggestions by readers of the Yearbook will be welcomed.

Robert C. Horton, *Director*

# Acknowledgments

The chapters of this volume were written by the State Mineral Officers of the Bureau of Mines, located throughout the country.

The Statistical Summary chapter and the tabular material covering total State mineral production, value of mineral production by county, and economic indicators were prepared in the Office of the Assistant Director, Minerals Information. The Division of Publication reviewed the manuscripts upon which this volume was based to ensure statistical consistency among the tables, figures, and text between this volume and Volume I, and between this volume and those of former years.

Compilations contained in this volume were based largely on statistics and other data provided by the mineral industries. The Bureau gratefully acknowledges the willing contribution of these essential data by both companies and individuals.

In the collection of statistical and other mineral-industry information, the Bureau of Mines was also assisted by various State agencies through cooperative agreements. Many of the chapters in Volume II were reviewed by staff members of these agencies; in some instances the staff members collaborated in preparing the chapters and are shown as coauthors. Our sincere appreciation for this assistance is extended to the following cooperating organizations:

Alabama: Geological Survey of Alabama.
Alaska: Division of Geological and Geophysical Surveys, Alaska Department of Natural Resources.
Arizona: Arizona Department of Mines and Mineral Resources.
Arkansas: Arkansas Geological Commission.
California: California Department of Conservation, Division of Mines and Geology.
Colorado: Colorado Geological Survey.
Connecticut: State Geological and Natural History Survey of Connecticut, Department of Environmental Protection.
Delaware: Delaware Geological Survey.
Florida: Florida Bureau of Geology.
Georgia: Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources.
Hawaii: Department of Land and Natural Resources.
Idaho: Idaho Geological Survey, University of Idaho.
Illinois: State Geological Survey Division, Illinois Department of Energy and Natural Resources.
Indiana: Geological Survey, Indiana Department of Natural Resources.
Iowa: Iowa Geological Survey.
Kansas: Kansas Geological Survey.
Kentucky: Kentucky Geological Survey.
Louisiana: Louisiana Geological Survey.
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Massachusetts: Office of the State Geologist, Massachusetts Department of Environmental Quality.
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Mississippi: Bureau of Geology and Energy Resources, Mississippi Department of Natural Resources.

Missouri: Missouri Department of Natural Resources, Division of Geology and Land Survey.
Montana: Montana Bureau of Mines and Geology.
Nebraska: Conservation and Survey Division of the University of Nebraska (Nebraska Geological Survey).
Nevada: Nevada Bureau of Mines and Geology.
New Hampshire: New Hampshire Department of Resources and Economic Development.
New Jersey: Geological Survey, Division of Water Resources, New Jersey Department of Environmental Protection.
New Mexico: New Mexico Bureau of Mines and Mineral Resources.
New York: New York State Education Department, Geological Survey.
North Carolina: Division of Land Resources, North Carolina Department of Natural Resources and Community Development.
North Dakota: North Dakota Geological Survey.
Oklahoma: Oklahoma Geological Survey.
Oregon: Oregon Department of Geology and Mineral Industries.
Pennsylvania: Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources.
Puerto Rico: Department of Natural Resources.
Rhode Island: Department of Environmental Management.
South Carolina: South Carolina Geological Survey, State Division of Research and Statistical Services.
South Dakota: South Dakota Geological Survey.
Tennessee: Tennessee Division of Geology.
Texas: Bureau of Economic Geology, The University of Texas at Austin.
Utah: Utah Geological and Mineral Survey.
Vermont: Office of the State Geologist, Agency of Environmental Conservation.
Virginia: Virginia Division of Mineral Resources.
Washington: Washington Division of Geology and Earth Resources.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Wisconsin Geological and Natural History Survey.
Wyoming: Geological Survey of Wyoming.

Albert E. Schreck, *Chief, Division of Publication*

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# Statistical Summary

### By Rose L. Ballard[1]

This chapter summarizes data on crude nonfuel mineral production for the United States, its island possessions, and the Commonwealth of Puerto Rico. Included also are the tables that show the principal nonfuel mineral commodities exported from and imported into the United States and that compare world and U.S. mineral production. The detailed data from which these tables were derived are contained in the individual commodity chapters of Volume I and in the State chapters of Volume II of this edition of the Minerals Yearbook.

Although crude mineral production may be measured at any of several stages of extraction and processing, the stage of measurement used in this chapter is what is normally termed "mine output." It usually refers to minerals or ores in the form in which they are first extracted from the ground, but customarily includes the output from auxiliary processing at or near the mines.

Because of inadequacies in the statistics available, some series deviate from the foregoing definition. For copper, gold, lead, silver, tin, and zinc, the quantities are recorded on a mine basis (as the recoverable content of ore sold or treated). However, the values assigned to these quantities are based on the average selling price of refined metal, not the mine value. Mercury is measured as recovered metal and valued at the average New York price for the metal.

The weight or volume units shown are those customarily used in the particular industries producing the commodities. Values shown are in current dollars, with no adjustments made to compensate for changes in the purchasing power of the dollar.

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[1] Statistical specialist, Minerals Information.

## Table 1.—Nonfuel mineral production[1] in the United States

| Mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **METALS** |  |  |  |  |  |  |
| Antimony ore and concentrate short tons, antimony content | 503 | W | 838 | W | 557 | W |
| Bauxite thousand metric tons, dried equivalent | 732 | $12,334 | 679 | $11,309 | 856 | $15,643 |
| Copper (recoverable content of ores, etc.) metric tons | 1,146,975 | 1,840,856 | 1,038,098 | 1,751,476 | 1,091,284 | 1,608,422 |
| Gold (recoverable content of ores, etc.) troy ounces | 1,465,686 | 550,968 | [r]1,956,400 | [r]829,514 | 2,058,784 | 742,517 |
| Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight | 35,751 | 1,491,705 | 44,295 | 1,938,496 | W | W |
| Iron oxide pigments, crude short tons | [r]46,548 | [r]2,059 | [r]41,875 | [r]2,427 | 53,017 | 2,819 |
| Lead (recoverable content of ores, etc.) metric tons | 512,516 | 288,579 | [r]449,216 | [r]214,708 | 321,897 | 181,305 |
| Manganiferous ore (5% to 35% Mn) short tons, gross weight | 31,509 | 293 | 33,523 | 216 | 88,423 | 860 |
| Mercury 76-pound flasks | 25,760 | W | 25,070 | W | 19,048 | W |
| Molybdenum (content of concentrate) thousand pounds | 76,135 | 504,089 | [r]48,805 | [r]166,612 | 102,405 | 326,780 |
| Nickel (content of ore and concentrate) short tons | 3,203 | W | -- | -- | 14,540 | W |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 40,248 | 319,975 | 43,415 | 496,671 | 44,440 | 361,773 |
| Titanium concentrate: Ilmenite short tons, gross weight | 233,063 | 19,093 | W | W | W | W |
| Tungsten ore and concentrate metric tons, contained W | 1,575 | 22,062 | 1,016 | 10,528 | 1,173 | 13,409 |
| Vanadium (recoverable in ore and concentrate) short tons | 4,098 | 52,577 | 2,171 | 30,675 | 1,617 | 24,551 |
| Zinc (recoverable content of ores, etc.) metric tons | 303,160 | 257,116 | 275,294 | 251,204 | 252,768 | 270,833 |
| Combined value of beryllium concentrates, magnesium chloride for magnesium metal, rare-earth metal concentrate, tin, titanium concentrate (rutile), zircon concentrate, and values indicated by symbol W | XX | 154,917 | XX | [r]133,220 | XX | 2,427,624 |
| Total | XX | 5,517,000 | XX | [r]5,837,000 | XX | 5,977,000 |
| **NONMETALS (EXCEPT FUELS)** |  |  |  |  |  |  |
| Abrasive stones[2] short tons | 1,285 | 553 | 1,101 | 482 | 1,290 | 602 |
| Asbestos metric tons | 63,515 | 24,917 | 69,906 | 27,866 | 57,422 | 24,238 |
| Barite thousand short tons | 1,845 | 69,522 | 754 | 29,203 | 775 | 25,445 |
| Boron minerals do | 1,234 | 384,597 | 1,303 | 439,181 | 1,367 | 456,687 |
| Bromine thousand pounds | 401,100 | 102,600 | 370,000 | 91,000 | 385,000 | 95,000 |
| Calcium chloride short tons | [e]616,513 | [e]61,483 | W | W | [e]838,000 | [e]93,000 |
| Carbon dioxide, natural thousand cubic feet | 2,067,500 | 3,399 | -- | -- | -- | -- |
| Cement: |  |  |  |  |  |  |
| Masonry thousand short tons | 2,364 | 145,172 | 2,921 | 186,240 | 3,281 | 219,877 |
| Portland do | 61,080 | 3,084,439 | 67,183 | 3,315,690 | 74,376 | 3,810,446 |
| Clays do | 35,345 | 825,064 | 40,858 | 931,091 | 44,236 | 1,037,233 |
| Diatomite do | 613 | 107,619 | 619 | 114,279 | 627 | 120,926 |
| Feldspar short tons | 615,000 | 20,300 | 710,000 | 22,500 | 710,000 | 23,500 |
| Fluorspar do | 77,017 | 13,293 | [e]61,000 | [e]10,000 | 72,000 | W |
| Garnet (abrasive) do | 27,303 | 2,321 | 29,767 | 2,533 | 29,647 | [e]2,487 |
| Gem stones[e] | NA | 7,150 | NA | 7,425 | NA | 7,450 |
| Gypsum thousand short tons | 10,538 | 89,131 | 12,884 | 101,361 | 14,319 | 113,671 |
| Helium (Grade-A) million cubic feet | [3]1,248 | [3]42,432 | [3]1,299 | [3]45,465 | 1,654 | 62,026 |
| Lime thousand short tons | 14,075 | 696,207 | 14,867 | 757,611 | 15,922 | 811,183 |
| Magnesium compounds short tons | W | W | [r]618,227 | [r]182,495 | W | W |
| Mica (scrap) thousand short tons | 106 | 6,398 | 140 | 6,479 | 161 | 7,139 |
| Peat do | 769 | 16,871 | 725 | 18,667 | 814 | 19,907 |
| Perlite short tons | 506,000 | 16,044 | 474,000 | 15,664 | 498,000 | 16,638 |
| Phosphate rock thousand metric tons | 37,414 | 950,326 | 42,573 | [r]1,021,095 | 49,197 | 1,182,244 |
| Potassium salts ($K_2O$ equivalent) do | 1,784 | 265,600 | 1,513 | 220,800 | 1,639 | 241,800 |

See footnotes at end of table.

## Table 1.—Nonfuel mineral production[1] in the United States —Continued

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| NONMETALS (EXCEPT FUELS) — Continued | | | | | | |
| Pumice _ _ _ _ _ thousand short tons_ _ | 416 | $3,750 | 449 | $4,486 | 502 | $4,929 |
| Pyrites _ _ _ _ thousand metric tons_ _ | 676 | 41,943 | W | W | W | W |
| Salt _ _ _ _ _ _ _ thousand short tons_ _ | 37,894 | 671,424 | 34,573 | 597,081 | 39,225 | 675,099 |
| Sand and gravel: | | | | | | |
| Construction _ _ _ _ _ _ _ _ _ _do_ _ _ _ | 594,000 | 1,674,000 | [e]655,100 | [e]1,935,000 | 773,900 | 2,244,000 |
| Industrial _ _ _ _ _ _ _ _ _ _ _ _do_ _ _ _ | 27,400 | 323,800 | 26,620 | 335,200 | 29,380 | 377,200 |
| Sodium sulfate (natural) _ _ _ _do_ _ _ _ | W | W | 423 | 39,425 | 435 | 40,125 |
| Stone:[4] | | | | | | |
| Crushed _ _ _ _ _ _ _ _ _ _ _ _ _ _do_ _ _ _ | [e]790,030 | [e]2,918,300 | [r]861,600 | [r]3,327,000 | [e]956,000 | [e]3,755,600 |
| Dimension_ _ _ _ _ _ _ _ _ _ _ _ _do_ _ _ _ | [r] [e]1,089 | [r] [e]137,671 | [r]1,090 | [r]147,843 | [e]1,157 | [e]154,949 |
| Sulfur, Frasch process thousand metric tons_ _ | 3,598 | 434,660 | 4,111 | [r]414,210 | 5,001 | 546,106 |
| Talc and pyrophyllite thousand short tons_ _ | 1,135 | 20,671 | 1,066 | 20,280 | 1,170 | 24,745 |
| Tripoli _ _ _ _ _ _ _ _ _ _ _ _ _short tons_ _ | 112,928 | 653 | 111,020 | 649 | 124,482 | 699 |
| Vermiculite _ _ thousand short tons_ _ | 316 | 28,508 | 282 | 27,170 | 315 | 31,500 |
| Combined value of aplite, asphalt (native), emery, graphite, helium (crude), iodine, kyanite, lithium minerals, magnesite, marl (greensand), olivine, sodium carbonate (natural), staurolite, wollastonite, and values indicated by symbol W _ _ _ _ _ | XX | 959,269 | XX | [r]867,486 | XX | 946,109 |
| Total _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ | XX | [r]14,150,000 | XX | [r]15,263,000 | XX | 17,173,000 |
| Grand total _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ | XX | [r]19,667,000 | XX | [r]21,100,000 | XX | 23,150,000 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Grindstones, pulpstones, and sharpening stones; excludes mill liners and grinding pebbles.

[3] Excludes output in New Mexico; withheld to avoid disclosing company proprietary data; included in nonmetals "Combined value" figure for 1982-83.

[4] Excludes abrasive stone and bituminous limestone and sandstone; all included elsewhere in table.

## Table 2.—Nonfuel minerals produced in the United States and principal producing States in 1984

| Mineral | Principal producing States, in order of quantity | Other producing States |
|---|---|---|
| Antimony ore and concentrate | Idaho. | |
| Aplite | Va. | |
| Asbestos | Calif. and Vt. | |
| Asphalt (native) | Tex. and Utah. | |
| Barite | Nev., Ga., Mo., Mont | Ill., Tenn., Wash. |
| Bauxite | Ark., Ala., Ga. | |
| Beryllium concentrate | Utah and S. Dak. | |
| Boron minerals | Calif. | |
| Bromine | Ark. and Mich. | |
| Calcium chloride | Mich. and Calif. | |
| Cement | Tex., Calif., Pa., Mich | All other States except Conn., Del., Mass., Minn., N.H., N.J., N.C., N. Dak., R.I., Vt. |
| Clays | Ga., Tex., Miss., Wyo | All other States except Alaska, Del., Hawaii, R.I., Vt., Wis. |
| Copper (mine) | Ariz., N. Mex., Utah, Mont | Calif., Colo., Idaho, Mo., Nev., Tenn. |
| Diatomite | Calif., Nev., Wash., Oreg. | |
| Emery | N.Y. | |
| Feldspar | N.C., Conn., Ga., Calif | Okla. and S. Dak. |
| Fluorspar | Ill., Nev., Tex. | |
| Garnet, abrasive | Idaho, Maine, N.Y. | |
| Gold (mine) | Nev., S. Dak., Utah, Mont | Alaska, Ariz., Calif., Colo., Idaho, N. Mex., Oreg., Wash. |
| Gypsum | Tex., Okla., Mich., Iowa | Ariz., Ark., Calif., Colo., Idaho, Ind., Kans., La., Mont., Nev., N. Mex., N.Y., Ohio, S. Dak., Utah, Va., Wash., Wyo. |
| Helium | Kans., Tex., N. Mex. | |
| Iodine | Okla. and Mich. | |
| Iron ore | Minn., Mich., Mo., Tex | Calif., Colo., Mont., Nev. |
| Iron oxide pigments (crude) | Mich., Ga., Mo., Va. | |
| Kyanite | Va. and Ga. | |
| Lead (mine) | Mo., Idaho, Colo., N.Y | Ariz., Calif., Ill., Mont., Nev., Tenn., Utah. |
| Lime | Ohio, Pa., Mo., Ky | All other States except Alaska, Del., Ga., Maine, Miss., N.H., N.J., N. Mex., N.C., R.I., S.C., Vt. |
| Lithium minerals | N.C. and Nev. | |
| Magnesite | Nev. | |
| Magnesium chloride | Tex. | |
| Magnesium compounds | Mich., Calif., Fla., Tex | Del., N.J., Utah. |
| Manganiferous ore | Minn. and S.C. | |
| Marl, greensand | N.J. and Del. | |
| Mercury | Nev. | |
| Mica (scrap) | N.C., S. Dak., N. Mex., S.C | Conn., Ga., Pa., Tex. |
| Molybdenum | Colo., Ariz., Idaho, N. Mex | Calif., Nev., Utah. |
| Olivine | N.C. and Wash. | |
| Peat | Fla., Mich., Ind., Ill | Calif., Colo., Ga., Iowa, Maine, Md., Mass., Minn., Mont., N.J., N.Y., N.C., N. Dak., Ohio, Pa., S.C., Wash., Wis. |
| Perlite | N. Mex., Calif., Ariz., Nev | Colo. and Idaho. |
| Phosphate rock | Fla., N.C., Idaho, Tenn | Mont. and Utah. |
| Potassium salts | N. Mex., Utah, Calif. | |
| Pumice | Oreg., N. Mex., Calif., Idaho | Ariz., Hawaii, Kans., Okla. |
| Pyrites, ore and concentrate | Tenn., Colo., Ariz. | |
| Rare-earth metal concentrate | Calif. and Fla. | |
| Salt | La., Tex., N.Y., Ohio | Ala., Ariz., Calif., Colo., Kans., Mich., Nev., N. Mex., N. Dak., Okla., Utah, W. Va. |
| Sand and gravel: | | |
| Construction | Calif., Tex., Mich., Ohio | All other States. |
| Industrial | Ill., Mich., N.J., Calif | All other States except Alaska, Del., Hawaii, Iowa, Maine, N.H., N. Mex., N. Dak., Oreg., S. Dak., Vt., Wyo. |
| Silver (mine) | Idaho, Nev., Mont., Ariz | Alaska, Calif., Colo., Ill., Mo., N. Mex., N.Y., Oreg., S. Dak., Tenn., Utah, Wash. |
| Sodium carbonate (natural) | Wyo. and Calif. | |
| Sodium sulfate (natural) | Calif., Tex., Utah. | |
| Staurolite | Fla. | |
| Stone: | | |
| Crushed | Tex., Fla., Pa., Ill | All other States except Del. and N. Dak. |
| Dimension | Ga., Ind., N.C., Vt | All other States except Alaska, Ark., Del., Fla., Hawaii, Ill., Iowa, Ky., La., Miss., Neb., Nev., N. Dak., Oreg., Utah, Wash., W. Va., Wyo. |
| Sulfur (Frasch) | Tex. and La. | |
| Talc and pyrophyllite | Tex., Mont., Vt., N.Y | Ark., Calif., Ga., N.C., Oreg., Va., Wash. |
| Tin | Alaska, Colo., Ariz. | |
| Titanium concentrate | Fla. and N.Y. | |
| Tripoli | Ill., Okla., Ark. | |
| Tungsten ore and concentrate | Calif., Colo., Nev., N. Mex. | |
| Vanadium | Colo., Idaho, Utah, Ark. | |
| Vermiculite | Mont., S.C., Va. | |
| Wollastonite | N.Y. and Calif. | |
| Zinc (mine) | Tenn., N.Y., Mo., Colo | Idaho, Ill., Ky., N.J., Utah. |
| Zircon concentrate | Fla. | |

## Table 3.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1984

| State | Value (thousands) | Rank | Percent of U.S. total | Principal minerals, in order of value |
|---|---|---|---|---|
| Alabama | $409,841 | 22 | 1.77 | Cement, stone (crushed), lime, clays. |
| Alaska | 88,683 | 42 | .38 | Sand and gravel (construction), stone (crushed), gold, cement. |
| Arizona | 1,483,479 | 5 | 6.41 | Copper, sand and gravel (construction), cement, molybdenum. |
| Arkansas | 272,628 | 27 | 1.18 | Bromine, cement, stone (crushed), sand and gravel (construction). |
| California | 2,003,445 | 1 | 8.66 | Cement, boron minerals, sand and gravel (construction), stone (crushed). |
| Colorado | 436,082 | 20 | 1.88 | Molybdenum, cement, sand and gravel (construction), stone (crushed). |
| Connecticut | 79,696 | 43 | .34 | Stone (crushed), sand and gravel (construction), feldspar, sand and gravel (industrial). |
| Delaware | [1]2,813 | 50 | .01 | Magnesium compounds, sand and gravel (construction). |
| Florida | 1,510,364 | 4 | 6.52 | Phosphate rock, stone (crushed), cement, sand and gravel (construction). |
| Georgia | 940,492 | 7 | 4.06 | Clays, stone (crushed), cement, stone (dimension). |
| Hawaii | 51,247 | 44 | .22 | Stone (crushed), cement, sand and gravel (construction), lime. |
| Idaho | 412,295 | 21 | 1.78 | Silver, phosphate rock, molybdenum, gold. |
| Illinois | 471,861 | 18 | 2.04 | Stone (crushed), cement, sand and gravel (construction), sand and gravel (industrial). |
| Indiana | 293,236 | 25 | 1.27 | Stone (crushed), cement, sand and gravel (construction), lime. |
| Iowa | 253,445 | 29 | 1.10 | Stone (crushed), cement, sand and gravel (construction), gypsum. |
| Kansas | 312,010 | 24 | 1.35 | Cement, salt, stone (crushed), helium (Grade-A). |
| Kentucky | 256,998 | 28 | 1.11 | Stone (crushed), lime, cement, sand and gravel (construction). |
| Louisiana | 511,470 | 16 | 2.21 | Sulfur (Frasch), salt, sand and gravel (construction), cement. |
| Maine | 37,939 | 46 | .16 | Sand and gravel (construction), cement, stone (crushed), peat. |
| Maryland | 241,701 | 32 | 1.04 | Cement, stone (crushed), sand and gravel (construction), clays. |
| Massachusetts | 107,332 | 39 | .46 | Sand and gravel (construction), stone (crushed), lime, stone (dimension). |
| Michigan | 1,408,607 | 6 | 6.08 | Iron ore, cement, magnesium compounds, salt. |
| Minnesota | 1,676,247 | 3 | 7.24 | Iron ore, sand and gravel (construction), stone (crushed), sand and gravel (industrial). |
| Mississippi | 94,178 | 41 | .41 | Sand and gravel (construction), clays, cement, stone (crushed). |
| Missouri | 731,897 | 8 | 3.16 | Cement, lead, stone (crushed), lime. |
| Montana | 249,363 | 30 | 1.08 | Gold, silver, copper, cement. |
| Nebraska | 100,368 | 40 | .43 | Cement, sand and gravel (construction), stone (crushed), lime. |
| Nevada | 615,753 | 11 | 2.66 | Gold, silver, diatomite, molybdenum. |
| New Hampshire | 23,112 | 47 | .10 | Sand and gravel (construction), stone (dimension), stone (crushed), clays. |
| New Jersey | 156,236 | 35 | .68 | Stone (crushed), sand and gravel (industrial), sand and gravel (construction), zinc. |
| New Mexico | 619,144 | 10 | 2.68 | Copper, potassium salts, molybdenum, cement. |
| New York | 612,490 | 12 | 2.65 | Cement, stone (crushed), salt, sand and gravel (construction). |
| North Carolina | 451,480 | 19 | 1.95 | Stone (crushed), phosphate rock, lithium compounds, sand and gravel (construction). |
| North Dakota | 21,794 | 48 | .10 | Sand and gravel (construction), lime, salt, clays. |
| Ohio | 552,903 | 13 | 2.39 | Stone (crushed), salt, sand and gravel (construction), lime. |
| Oklahoma | 245,732 | 31 | 1.06 | Cement, stone (crushed), sand and gravel (construction), gypsum. |
| Oregon | 120,402 | 37 | .52 | Stone (crushed), sand and gravel (construction), cement, lime. |
| Pennsylvania | 708,356 | 9 | 3.06 | Cement, stone (crushed), lime, sand and gravel (construction). |
| Rhode Island | 11,568 | 49 | .05 | Stone (crushed), sand and gravel (construction), sand and gravel (industrial), stone (dimension). |
| South Carolina | 275,850 | 26 | 1.19 | Cement, stone (crushed), clays, sand and gravel (construction). |
| South Dakota | 193,407 | 34 | .84 | Gold, cement, stone (dimension), stone (crushed). |
| Tennessee | 478,321 | 17 | 2.07 | Stone (crushed), zinc, cement, pyrites. |
| Texas | 1,715,407 | 2 | 7.41 | Cement, stone (crushed), sulfur (Frasch), sand and gravel (construction). |
| Utah | 524,162 | 15 | 2.26 | Copper, gold, cement, sand and gravel (construction). |
| Vermont | 45,098 | 45 | .20 | Stone (dimension), sand and gravel (construction), stone (crushed), asbestos. |
| Virginia | 341,589 | 23 | 1.48 | Stone (crushed), cement, sand and gravel (construction), lime. |
| Washington | 202,624 | 33 | .88 | Cement, sand and gravel (construction), stone (crushed), lime. |

See footnotes at end of table.

## Table 3.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1984 —Continued

| State | Value (thousands) | Rank | Percent of U.S. total | Principal minerals, in order of value |
|---|---|---|---|---|
| West Virginia | $112,187 | 38 | 0.48 | Stone (crushed), cement, sand and gravel (industrial), salt. |
| Wisconsin | 129,348 | 36 | .56 | Stone (crushed), sand and gravel (construction), lime, sand and gravel (industrial). |
| Wyoming | 549,292 | 14 | 2.37 | Sodium carbonate, clays, cement (portland), sand and gravel (construction). |
| Total | 23,150,000 | XX | 100.00 | |

XX Not applicable.
[1] Incomplete total.

## Table 4.—Value of nonfuel mineral production per capita and per square mile in 1984, by State

| State | Area (square miles) | Population (thousands) | Value of mineral production | | | | |
|---|---|---|---|---|---|---|---|
| | | | Total (thousands) | Per square mile | | Per capita | |
| | | | | Dollars | Rank | Dollars | Rank |
| Alabama | 51,705 | 3,990 | $409,841 | 7,926 | 23 | 103 | 20 |
| Alaska | 591,004 | 500 | 88,683 | 150 | 50 | 177 | 10 |
| Arizona | 114,000 | 3,053 | 1,483,479 | 13,013 | 10 | 486 | 3 |
| Arkansas | 53,187 | 2,349 | 272,628 | 5,126 | 30 | 116 | 17 |
| California | 158,706 | 25,622 | 2,003,445 | 12,624 | 12 | 78 | 25 |
| Colorado | 104,091 | 3,178 | 436,082 | 4,190 | 36 | 137 | 15 |
| Connecticut | 5,018 | 3,154 | 79,696 | 15,882 | 7 | 25 | 45 |
| Delaware | 2,044 | 613 | [1]2,813 | 1,376 | 45 | 5 | 50 |
| Florida | 58,664 | 10,976 | 1,510,364 | 25,746 | 1 | 138 | 14 |
| Georgia | 58,910 | 5,837 | 940,492 | 15,965 | 6 | 161 | 11 |
| Hawaii | 6,471 | 1,039 | 51,247 | 7,920 | 24 | 49 | 36 |
| Idaho | 83,564 | 1,001 | 412,295 | 4,934 | 32 | 412 | 5 |
| Illinois | 56,345 | 11,511 | 471,861 | 8,374 | 21 | 41 | 39 |
| Indiana | 36,185 | 5,498 | 293,236 | 8,104 | 22 | 53 | 34 |
| Iowa | 56,275 | 2,910 | 253,445 | 4,504 | 35 | 87 | 22 |
| Kansas | 82,277 | 2,438 | 312,010 | 3,792 | 37 | 128 | 16 |
| Kentucky | 40,409 | 3,723 | 256,998 | 6,360 | 26 | 69 | 28 |
| Louisiana | 47,751 | 4,462 | 511,470 | 10,711 | 15 | 115 | 18 |
| Maine | 33,265 | 1,156 | 37,939 | 1,140 | 48 | 33 | 42 |
| Maryland | 10,460 | 4,349 | 241,701 | 23,107 | 3 | 56 | 33 |
| Massachusetts | 8,284 | 5,798 | 107,332 | 12,957 | 11 | 19 | 48 |
| Michigan | 58,527 | 9,075 | 1,408,607 | 24,068 | 2 | 155 | 12 |
| Minnesota | 84,402 | 4,162 | 1,676,247 | 19,860 | 5 | 403 | 6 |
| Mississippi | 47,689 | 2,598 | 94,178 | 1,975 | 43 | 36 | 40 |
| Missouri | 69,697 | 5,008 | 731,897 | 10,501 | 16 | 146 | 13 |
| Montana | 147,046 | 824 | 249,363 | 1,696 | 44 | 303 | 8 |
| Nebraska | 77,355 | 1,606 | 100,368 | 1,298 | 46 | 62 | 29 |
| Nevada | 110,561 | 911 | 615,753 | 5,569 | 29 | 676 | 2 |
| New Hampshire | 9,279 | 977 | 23,112 | 2,491 | 41 | 24 | 46 |
| New Jersey | 7,787 | 7,515 | 156,236 | 20,064 | 4 | 21 | 47 |
| New Mexico | 121,593 | 1,424 | 619,144 | 5,092 | 31 | 435 | 4 |
| New York | 49,108 | 17,735 | 612,490 | 12,472 | 13 | 35 | 41 |
| North Carolina | 52,669 | 6,165 | 451,480 | 8,572 | 19 | 73 | 27 |
| North Dakota | 70,703 | 686 | 21,794 | 308 | 49 | 32 | 43 |
| Ohio | 41,330 | 10,752 | 552,903 | 13,378 | 9 | 51 | 35 |
| Oklahoma | 69,956 | 3,298 | 245,732 | 3,513 | 38 | 75 | 26 |
| Oregon | 97,073 | 2,674 | 120,402 | 1,240 | 47 | 45 | 38 |
| Pennsylvania | 45,308 | 11,901 | 708,356 | 15,634 | 8 | 60 | 31 |
| Rhode Island | 1,212 | 962 | 11,568 | 9,545 | 17 | 12 | 49 |
| South Carolina | 31,113 | 3,300 | 275,850 | 8,866 | 18 | 84 | 24 |
| South Dakota | 77,116 | 706 | 193,407 | 2,508 | 40 | 274 | 9 |
| Tennessee | 42,144 | 4,717 | 478,321 | 11,350 | 14 | 101 | 21 |
| Texas | 266,807 | 15,989 | 1,715,407 | 6,429 | 25 | 107 | 19 |
| Utah | 84,899 | 1,652 | 524,162 | 6,174 | 27 | 317 | 7 |
| Vermont | 9,614 | 530 | 45,098 | 4,691 | 33 | 85 | 23 |
| Virginia | 40,767 | 5,636 | 341,589 | 8,379 | 20 | 61 | 30 |
| Washington | 68,138 | 4,349 | 202,624 | 2,974 | 39 | 47 | 37 |
| West Virginia | 24,231 | 1,952 | 112,187 | 4,630 | 34 | 57 | 32 |
| Wisconsin | 56,153 | 4,766 | 129,348 | 2,304 | 42 | 27 | 44 |
| Wyoming | 97,809 | 511 | 549,292 | 5,616 | 28 | 1,075 | 1 |
| Total[2] or average | 3,618,701 | 235,538 | 23,150,000 | 6,397 | XX | 98 | XX |

XX Not applicable.
[1] Incomplete total.
[2] Excludes Washington, DC (which has no mineral production), with an area of 69 square miles and a population of 623,000.

## Table 5.—Nonfuel mineral production[1] in the United States, by State

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **ALABAMA** | | | | | | |
| Cement: | | | | | | |
| Masonry thousand short tons | 150 | $9,086 | 210 | $13,417 | 259 | $17,247 |
| Portland do. | 2,558 | 104,461 | 3,279 | 150,255 | 3,656 | 167,191 |
| Clays[2] do. | 1,323 | 13,193 | 1,863 | 20,758 | 1,906 | 30,500 |
| Gem stones | NA | 1 | NA | 1 | NA | 1 |
| Lime thousand short tons | 907 | 42,380 | 981 | 41,149 | 1,163 | 50,560 |
| Sand and gravel: | | | | | | |
| Construction do. | 7,019 | 17,226 | [e]8,600 | [e]23,500 | 10,348 | 26,188 |
| Industrial do. | 960 | 8,096 | 418 | 3,256 | 442 | 3,600 |
| Stone: | | | | | | |
| Crushed do. | [e]21,200 | [e]89,600 | 20,558 | 95,374 | [e]22,000 | [e]98,500 |
| Dimension do. | [r] [e]4 | [r] [e]2,094 | 7 | 2,661 | [e]8 | [e]2,674 |
| Combined value of bauxite, clays (bentonite), phosphate rock (1982-83), and salt | XX | 13,025 | XX | [r]10,956 | XX | 13,380 |
| Total | XX | [r]299,162 | XX | [r]361,327 | XX | 409,841 |
| **ALASKA** | | | | | | |
| Gem stones | NA | $60 | NA | $60 | NA | $60 |
| Gold (recoverable content of ores, etc.) troy ounces | 30,513 | 11,470 | [r]39,523 | [r]16,758 | 23,232 | 8,379 |
| Sand and gravel (construction) thousand short tons | 40,832 | 74,895 | [e]45,200 | [e]97,200 | 30,861 | 66,883 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 2 | 17 | 4 | 47 | W | W |
| Stone (crushed) thousand short tons | [e]5,100 | [e]25,200 | 1,981 | 9,460 | [e]2,500 | [e]10,800 |
| Combined value of cement (portland, 1984), copper (1982-83), lead (1982-83), tin, and value indicated by symbol W | XX | 1,269 | XX | 971 | XX | 2,561 |
| Total | XX | 112,911 | XX | [r]124,496 | XX | 88,683 |
| **ARIZONA** | | | | | | |
| Clays thousand short tons | 143 | $998 | 151 | $1,425 | 138 | $819 |
| Copper (recoverable content of ores, etc.) metric tons | 769,521 | 1,235,055 | 678,216 | 1,144,285 | 746,453 | 1,100,182 |
| Gem stones | NA | 2,800 | NA | 2,800 | NA | 2,700 |
| Gold (recoverable content of ores, etc.) troy ounces | 61,050 | 22,949 | 61,991 | 26,284 | 51,548 | 18,591 |
| Gypsum thousand short tons | 175 | 1,205 | 265 | 1,929 | 261 | 2,332 |
| Lead (recoverable content of ores, etc.) metric tons | 359 | 202 | [r]155 | [r]74 | W | W |
| Lime thousand short tons | 326 | 17,080 | 340 | 16,700 | 359 | 17,304 |
| Molybdenum (content of concentrate) thousand pounds | 20,445 | 89,928 | 23,934 | [r]80,210 | 24,013 | 76,112 |
| Pumice thousand short tons | 1 | 7 | 2 | 15 | 2 | 21 |
| Sand and gravel: | | | | | | |
| Construction do. | 19,124 | 58,375 | [e]23,200 | [e]75,000 | 30,439 | 101,959 |
| Industrial do. | 107 | 1,617 | W | W | W | W |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 6,309 | 50,159 | 4,492 | 51,383 | 4,093 | 33,320 |
| Stone: | | | | | | |
| Crushed thousand short tons | [e]5,200 | [e]22,200 | 4,755 | 24,079 | [e]5,200 | [e]27,300 |
| Dimension do. | [r] [e](3) | [r] [e]1 | (3) | 1 | [e](3) | [e](3) |
| Combined value of cement, perlite, pyrites, salt, tin (1984), and values indicated by symbol W | XX | 79,105 | XX | 87,449 | XX | 102,839 |
| Total | XX | [r]1,581,681 | XX | [r]1,511,634 | XX | 1,483,479 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **ARKANSAS** |  |  |  |  |  |  |
| Abrasives short tons | 1,085 | $469 | W | W | W | W |
| Clays thousand short tons | 629 | 6,658 | 879 | $9,956 | 1,019 | $7,838 |
| Gem stones | NA | 200 | NA | 200 | NA | 200 |
| Sand and gravel: |  |  |  |  |  |  |
| Construction thousand short tons | 6,936 | 18,700 | [e]6,900 | [e]19,600 | 8,334 | 23,786 |
| Industrial do. | 471 | 5,625 | 386 | 4,796 | 459 | 6,207 |
| Stone: |  |  |  |  |  |  |
| Crushed do. | [e]13,100 | [e]48,500 | 13,448 | 51,267 | [e]15,200 | [e]59,800 |
| Dimension do. | [r] [e]9 | [r] [e]574 | 9 | 573 | -- | -- |
| Talc do. | 13 | 92 | 7 | 66 | W | W |
| Combined value of barite (1982), bauxite, bromine, cement, gypsum, lime, tripoli, vanadium (1982 and 1984), and values indicated by symbol W | XX | 169,754 | XX | 159,972 | XX | 174,797 |
| Total | XX | [r]250,572 | XX | 246,430 | XX | 272,628 |
| **CALIFORNIA** |  |  |  |  |  |  |
| Boron minerals thousand short tons | 1,234 | $384,597 | 1,303 | $439,181 | 1,367 | $456,687 |
| Cement, portland do. | 6,464 | 401,883 | 7,567 | 420,949 | 8,715 | 520,026 |
| Clays do. | 1,762 | 15,642 | [2]1,816 | [2]18,255 | [2]2,100 | [2]23,868 |
| Diatomite do. | 340 | 68,139 | W | W | W | W |
| Gem stones | NA | 250 | NA | 300 | NA | 500 |
| Gold (recoverable content of ores, etc.) troy ounces | 10,547 | 3,965 | 38,443 | 16,300 | 85,858 | 30,965 |
| Gypsum thousand short tons | 1,088 | 10,614 | 1,213 | 10,668 | 1,382 | 12,443 |
| Lime do. | 364 | 23,000 | 358 | 22,994 | 406 | 26,827 |
| Peat do. | W | W | 13 | 612 | W | W |
| Pumice do. | 59 | 1,285 | 65 | 1,582 | 80 | 1,600 |
| Sand and gravel: |  |  |  |  |  |  |
| Construction do. | 81,147 | 270,995 | [e]91,000 | [e]308,700 | 102,420 | 360,427 |
| Industrial do. | 2,167 | 27,528 | 2,150 | 34,066 | 2,281 | 39,176 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 34 | 271 | 27 | 308 | W | W |
| Stone: |  |  |  |  |  |  |
| Crushed thousand short tons | [e]28,500 | [e]105,400 | 35,582 | 146,289 | [e]38,600 | [e]158,000 |
| Dimension do. | [r] [e]20 | [r] [e]2,727 | 20 | 2,839 | [e]22 | [e]2,990 |
| Talc do. | 85 | 1,699 | 71 | 1,289 | 74 | 1,642 |
| Combined value of asbestos, calcium chloride, carbon dioxide (1982), cement (masonry), clays (fire clay, 1983-84), copper, feldspar, iron ore, lead, magnesium compounds, molybdenum (1982 and 1984), perlite, potassium salts, rare-earth metal concentrate, salt, sodium carbonate, sodium sulfate, tungsten ore and concentrate, wollastonite, and values indicated by symbol W | XX | 293,851 | XX | [r]359,218 | XX | 368,294 |
| Total | XX | [r]1,611,846 | XX | [r]1,783,550 | XX | 2,003,445 |
| **COLORADO** |  |  |  |  |  |  |
| Clays thousand short tons | 201 | $1,124 | 459 | $2,650 | 308 | $2,111 |
| Copper (recoverable content of ores, etc.) metric tons | 575 | 922 | W | W | W | W |
| Gem stones | NA | 80 | NA | 80 | NA | 80 |
| Gold (recoverable content of ores, etc.) troy ounces | 64,584 | 24,278 | 63,063 | 26,739 | 60,010 | 21,643 |
| Gypsum thousand short tons | 184 | 1,571 | W | W | 291 | W |
| Molybdenum thousand pounds | 41,691 | 360,626 | [r]W | [r]W | W | W |
| Peat thousand short tons | 47 | 275 | W | W | W | W |
| Sand and gravel: |  |  |  |  |  |  |
| Construction do. | 18,590 | 58,465 | [e]21,200 | [e]81,600 | 28,024 | 87,324 |
| Industrial do. | 222 | 3,266 | 212 | 3,233 | 149 | 2,213 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 1,934 | 15,378 | 2,146 | 24,546 | 2,200 | 17,909 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **COLORADO—Continued** |  |  |  |  |  |  |
| Stone: |  |  |  |  |  |  |
| Crushed ______ thousand short tons__ | [e]6,900 | [e]$27,800 | 6,790 | $22,749 | [e]7,200 | [e]$26,200 |
| Dimension ______________do____ | [e]1 | [r][e]86 | 1 | 86 | [e]1 | [e]87 |
| Combined value of beryllium concentrate (1982), carbon dioxide (1982), cement, iron ore, lead, lime, perlite, pyrites (1982 and 1984), salt (1982 and 1984), tin (1982 and 1984), tungsten ore and concentrate, vanadium, zinc, and values indicated by symbol W ______________________ | XX | 142,049 | XX | [r]175,969 | XX | 278,515 |
| Total ____________________ | XX | [r]635,920 | XX | 337,652 | XX | 436,082 |
| **CONNECTICUT** |  |  |  |  |  |  |
| Clays _________ thousand short tons__ | 56 | $329 | 86 | $515 | 99 | $565 |
| Lime ____________________do____ | 8 | 568 | 5 | 400 | W | W |
| Sand and gravel: |  |  |  |  |  |  |
| Construction______________do____ | 4,887 | 16,237 | [e]5,000 | [e]17,900 | 6,718 | 22,817 |
| Industrial ______________do____ | 80 | 1,746 | W | W | W | W |
| Stone: |  |  |  |  |  |  |
| Crushed_________________do____ | [e]6,100 | [e]32,700 | 7,692 | 45,890 | [e]8,300 | [e]49,400 |
| Dimension ______________do____ | [r][e]16 | [r][e]923 | 18 | 1,028 | [e]18 | [e]1,080 |
| Combined value of feldspar, gem stones, mica (scrap), and values indicated by symbol W _ | XX | 3,299 | XX | 5,480 | XX | 5,834 |
| Total ____________________ | XX | [r]55,802 | XX | 71,213 | XX | 79,696 |
| **DELAWARE** |  |  |  |  |  |  |
| Marl (greensand) __ thousand short tons__ | -- | -- | -- | -- | 1 | $18 |
| Sand and gravel (construction) ____do____ | 1,300 | $3,197 | [e]1,400 | [e]$3,200 | 1,003 | 2,795 |
| Total[4] __________________ | XX | 3,197 | XX | 3,200 | XX | 2,813 |
| **FLORIDA** |  |  |  |  |  |  |
| Cement: |  |  |  |  |  |  |
| Masonry _____ thousand short tons__ | 231 | $16,267 | 313 | $19,557 | 383 | $24,624 |
| Portland ________________do____ | 2,651 | 136,190 | 3,329 | 164,048 | 3,564 | 172,548 |
| Clays ____________________do____ | 672 | [2]31,339 | 684 | 31,566 | 772 | 34,048 |
| Gem stones______________________ | NA | 6 | NA | 6 | NA | 6 |
| Lime _________ thousand short tons__ | 103 | 5,828 | W | 13,881 | 171 | 9,379 |
| Peat ____________________do____ | 120 | 1,575 | 114 | 1,999 | 263 | 5,454 |
| Sand and gravel: |  |  |  |  |  |  |
| Construction______________do____ | 13,616 | 30,081 | [e]14,900 | [e]31,500 | 21,032 | 48,494 |
| Industrial ______________do____ | 341 | 4,257 | 329 | 3,447 | 1,533 | 9,815 |
| Stone (crushed) ______________do____ | [e]53,100 | [e]182,300 | 57,282 | 235,700 | [e]68,500 | [e]290,000 |
| Combined value of clays (kaolin, 1982), magnesium compounds, phosphate rock, rare-earth metal concentrate, staurolite, titanium concentrates (ilmenite and rutile), and zircon concentrates ______________ | XX | 815,155 | XX | [r]774,122 | XX | 915,996 |
| Total ____________________ | XX | 1,222,998 | XX | [r]1,275,826 | XX | 1,510,364 |
| **GEORGIA** |  |  |  |  |  |  |
| Clays _________ thousand short tons__ | 6,773 | $475,768 | 7,859 | $560,005 | 8,679 | $600,029 |
| Gem stones______________________ | NA | 20 | NA | 20 | NA | 20 |
| Sand and gravel: |  |  |  |  |  |  |
| Construction___ thousand short tons__ | 3,166 | 8,361 | [e]3,800 | [e]9,400 | 5,347 | 13,623 |
| Industrial ______________do____ | 541 | 6,793 | 539 | 7,298 | 478 | 6,795 |
| Stone: |  |  |  |  |  |  |
| Crushed_________________do____ | [e]34,800 | [e]153,500 | 41,100 | [r]186,193 | [e]45,900 | [e]220,000 |
| Dimension ______________do____ | [r][e]182 | [r][e]19,375 | [r]183 | [r]21,019 | [e]202 | [e]20,007 |
| Talc ____________________do____ | 20 | 141 | 14 | 101 | 15 | 104 |
| Combined value of barite, bauxite, cement, feldspar, iron oxide pigments (crude), kyanite, mica (scrap), and peat __________ | XX | 54,880 | XX | 65,536 | XX | 79,914 |
| Total ____________________ | XX | [r]718,838 | XX | [r]849,572 | XX | 940,492 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **HAWAII** | | | | | | |
| Cement: | | | | | | |
| Masonry ----- thousand short tons-- | 6 | $554 | 6 | $641 | 5 | $792 |
| Portland ----------------do---- | 227 | 18,122 | 216 | 20,673 | 186 | 18,282 |
| Sand and gravel (construction) ----do---- | 449 | 1,221 | [e]440 | [e]1,000 | 436 | 2,031 |
| Stone: | | | | | | |
| Crushed----------------do---- | [e]4,500 | [e]26,600 | 5,532 | 29,703 | [e]5,400 | [e]29,700 |
| Dimension --------------do---- | [e](3) | [e]4 | (3) | 3 | -- | -- |
| Combined value of gem stones, lime, and pumice -------------------- | XX | 388 | XX | 391 | XX | 442 |
| Total ------------------- | XX | 46,889 | XX | 52,411 | XX | 51,247 |
| **IDAHO** | | | | | | |
| Antimony ore and concentrate, antimony content--------------short tons-- | 294 | W | 585 | W | 557 | W |
| Clays --------- thousand short tons-- | 8 | $101 | 6 | $91 | [5]1 | $243 |
| Copper (recoverable content of ores, etc.) metric tons-- | 3,074 | 4,933 | 3,556 | 6,000 | 3,701 | 5,455 |
| Gem stones---------------------- | NA | 75 | NA | 100 | NA | 150 |
| Lead (recoverable content of ores, etc.) metric tons-- | W | W | [r]25,893 | [r]12,376 | W | W |
| Lime --------- thousand short tons-- | W | W | 85 | 7,686 | 87 | 5,616 |
| Phosphate rock -- thousand metric tons-- | W | W | W | W | 4,722 | 126,586 |
| Sand and gravel (construction) thousand short tons-- | 2,340 | 6,258 | [e]3,000 | [e]9,800 | 4,725 | 13,509 |
| Silver (recoverable content of ores, etc.) thousand troy ounces-- | 14,830 | 117,901 | 17,684 | 202,308 | 18,869 | 153,608 |
| Stone (crushed) --- thousand short tons-- | [e]1,200 | [e]6,000 | 1,935 | 7,480 | [e]1,800 | [e]7,100 |
| Combined value of cement, garnet (abrasive ), gold, gypsum, molybdenum (1984), perlite, pumice, sand and gravel (industrial), stone (dimension), tungsten ore and concentrate (1982-83), vanadium, zinc, and values indicated by symbol W -------- | XX | [r]168,041 | XX | 169,318 | XX | 100,028 |
| Total ------------------- | XX | [r]303,309 | XX | 415,159 | XX | 412,295 |
| **ILLINOIS** | | | | | | |
| Cement, portland -- thousand short tons-- | 1,757 | $78,444 | 1,857 | $74,975 | 1,997 | $82,622 |
| Clays[2]-------------------do---- | 455 | 2,305 | 717 | 3,360 | 253 | 940 |
| Gem stones---------------------- | NA | 15 | NA | 15 | NA | 15 |
| Peat ---------- thousand short tons-- | W | W | W | W | 49 | W |
| Sand and gravel: | | | | | | |
| Construction--------------do---- | 21,557 | 59,149 | [e]21,100 | [e]58,400 | 25,969 | 72,477 |
| Industrial ---------------do---- | 3,989 | 45,665 | 4,060 | 42,871 | 4,100 | 52,197 |
| Stone: | | | | | | |
| Crushed----------------do---- | [e]42,900 | [e]148,300 | 42,761 | 166,860 | [e]48,500 | [e]191,600 |
| Dimension --------------do---- | [e]2 | [r] [e]43 | 2 | 71 | -- | -- |
| Combined value of barite, cement (masonry), clays (fuller's earth), fluorspar, lead, lime, silver, tripoli, zinc, and values indicated by symbol W ------------------ | XX | 55,618 | XX | 60,355 | XX | 72,010 |
| Total ------------------- | XX | [r]389,539 | XX | 406,907 | XX | 471,861 |
| **INDIANA** | | | | | | |
| Cement, portland -- thousand short tons-- | 1,523 | $58,055 | W | W | W | W |
| Clays -------------------do---- | 501 | 1,221 | [2]558 | [2]$1,421 | [2]653 | [2]$2,085 |
| Gem stones---------------------- | NA | 1 | NA | 1 | NA | 1 |
| Peat ---------- thousand short tons-- | 89 | 2,243 | 81 | 1,973 | 61 | 1,358 |
| Sand and gravel: | | | | | | |
| Construction--------------do---- | 13,097 | 34,579 | [e]14,400 | [e]37,900 | 16,071 | 44,744 |
| Industrial ---------------do---- | W | W | W | W | 194 | 1,129 |
| Stone: | | | | | | |
| Crushed----------------do---- | [e]20,300 | [e]65,500 | 24,051 | 82,782 | [e]26,700 | [e]99,400 |
| Dimension --------------do---- | [r] [e]127 | [r] [e]11,626 | 144 | 11,015 | [e]159 | [e]14,269 |
| Combined value of abrasives (natural), cement (masonry), clays (fire clay, 1983-84), gypsum, lime, and values indicated by symbol W -------------------- | XX | 40,199 | XX | 115,450 | XX | 130,250 |
| Total ------------------- | XX | [r]213,424 | XX | 250,542 | XX | 293,236 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **IOWA** | | | | | | |
| Cement: | | | | | | |
| Masonry ----- thousand short tons-- | W | W | 37 | $3,425 | 42 | $3,260 |
| Portland ---------------do---- | 1,622 | $82,225 | 1,644 | 87,836 | 1,730 | 92,699 |
| Clays -------------------do---- | 437 | 2,392 | 576 | 3,258 | 623 | 2,695 |
| Gem stones------------------- | NA | 1 | NA | 1 | NA | W |
| Gypsum-------- thousand short tons-- | 1,177 | 11,345 | 1,612 | 13,518 | 1,527 | 12,421 |
| Peat--------------------do---- | W | W | W | W | 11 | 400 |
| Sand and gravel (construction)----do---- | 10,064 | 25,618 | $^{e}$11,800 | $^{e}$32,800 | 13,882 | 37,027 |
| Stone (crushed) -------------do---- | $^{e}$22,600 | $^{e}$88,800 | 24,844 | 101,097 | $^{e}$23,800 | $^{e}$100,000 |
| Combined value of lime, sand and gravel (industrial, 1982), stone (dimension, 1982-83), and values indicated by symbol W --- | XX | $^{r}$8,028 | XX | 5,425 | XX | 4,943 |
| Total-------------------- | XX | $^{r}$218,409 | XX | 247,360 | XX | 253,445 |
| **KANSAS** | | | | | | |
| Cement: | | | | | | |
| Masonry ----- thousand short tons-- | 46 | $2,628 | W | W | W | W |
| Portland ---------------do---- | 1,549 | 79,558 | W | W | W | W |
| Clays -------------------do---- | 664 | 3,656 | 718 | $3,921 | 918 | $5,537 |
| Gem stones------------------- | NA | 1 | NA | 1 | NA | 1 |
| Helium: | | | | | | |
| Crude ---------million cubic feet-- | -- | -- | 188 | 3,572 | 402 | 8,844 |
| Grade-A ---------------do---- | 790 | 26,860 | 775 | 27,125 | 1,015 | 38,063 |
| Salt[6]---------- thousand short tons-- | 1,601 | 72,146 | 1,719 | 67,195 | 1,712 | 71,558 |
| Sand and gravel: | | | | | | |
| Construction-------------do---- | 9,720 | 20,612 | $^{e}$12,400 | $^{e}$26,600 | 11,796 | 26,358 |
| Industrial -------------do---- | 331 | 3,635 | 199 | 2,184 | W | W |
| Stone: | | | | | | |
| Crushed-----------------do---- | $^{e}$14,400 | $^{e}$41,100 | $^{r}$12,687 | $^{r}$45,121 | $^{e}$13,600 | $^{e}$48,500 |
| Combined value of gypsum, lime, pumice, salt (brine), stone (dimension), and values indicated by symbol W -------------- | XX | $^{r}$6,728 | XX | 91,866 | XX | 113,149 |
| Total-------------------- | XX | $^{r}$256,924 | XX | $^{r}$267,585 | XX | 312,010 |
| **KENTUCKY** | | | | | | |
| Clays --------- thousand short tons-- | [2]579 | [2]$2,039 | [2]669 | [2]$2,142 | 802 | $7,277 |
| Gem stones------------------- | NA | 1 | NA | 1 | NA | 1 |
| Sand and gravel: | | | | | | |
| Construction--- thousand short tons-- | 6,499 | 15,936 | $^{e}$5,500 | $^{e}$13,000 | 7,839 | 18,252 |
| Industrial -------------do---- | 7 | 116 | 10 | 124 | W | W |
| Stone (crushed) -------------do---- | $^{e}$29,500 | $^{e}$104,300 | 33,399 | 117,842 | $^{e}$37,300 | $^{e}$133,000 |
| Combined value of cement, clays (ball clay, 1982-83, fire clay, 1983), lime, and zinc --- | XX | 84,555 | XX | 91,408 | XX | 98,468 |
| Total-------------------- | XX | 206,947 | XX | 224,517 | XX | 256,998 |
| **LOUISIANA** | | | | | | |
| Clays --------- thousand short tons-- | 326 | [2]$6,216 | [2]505 | $10,793 | 547 | [2]$10,858 |
| Gem stones------------------- | NA | 1 | NA | 1 | NA | 1 |
| Salt --------- thousand short tons-- | 12,171 | 117,569 | 11,544 | 100,936 | 13,101 | 112,142 |
| Sand and gravel: | | | | | | |
| Construction-------------do---- | 16,558 | 50,966 | $^{e}$14,200 | $^{e}$46,600 | 17,040 | 54,664 |
| Industrial -------------do---- | 378 | 4,590 | 291 | 4,252 | 266 | 3,757 |
| Stone (crushed) -------------do---- | W | W | 5,758 | 25,702 | $^{e}$4,100 | $^{e}$19,500 |
| Sulfur (Frasch) -- thousand metric tons-- | 1,239 | W | 1,643 | W | 2,007 | W |
| Combined value of cement, clays (bentonite, 1982 and 1984), gypsum, lime, and values indicated by symbol W ------------ | XX | 238,325 | XX | 258,477 | XX | 310,548 |
| Total-------------------- | XX | 417,667 | XX | 446,761 | XX | 511,470 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **MAINE** | | | | | | |
| Clays thousand short tons | 37 | $76 | 43 | $93 | 43 | $97 |
| Peat do. | 8 | 508 | W | W | W | W |
| Sand and gravel (construction) do. | 6,701 | 15,118 | [e]4,800 | [e]12,100 | 7,885 | 19,228 |
| Stone (crushed) do. | [e]1,200 | [e]4,000 | 848 | 2,851 | [e]1,300 | [e]4,400 |
| Combined value of other nonmetals and values indicated by symbol W | XX | [r]16,003 | XX | 11,319 | XX | 14,214 |
| Total | XX | [r]35,705 | XX | 26,363 | XX | 37,939 |
| **MARYLAND** | | | | | | |
| Clays[2] thousand short tons | 405 | $1,346 | 484 | $1,747 | 347 | $1,484 |
| Gem stones | NA | 2 | NA | 2 | NA | 2 |
| Lime thousand short tons | 7 | 396 | 7 | 383 | 7 | 419 |
| Peat do. | 4 | W | 4 | W | 5 | W |
| Sand and gravel (construction) do. | 9,720 | 32,386 | [e]10,600 | [e]37,800 | 14,234 | 46,671 |
| Stone: | | | | | | |
| Crushed do. | [e]15,100 | [e]73,500 | 19,284 | 80,429 | [e]22,100 | [e]94,000 |
| Dimension do. | [r] [e]10 | [r] [e]470 | 12 | 682 | [e]17 | [e]864 |
| Combined value of cement, clays (ball clay), sand and gravel (industrial, 1984), and values indicated by symbol W | XX | 62,891 | XX | 78,366 | XX | 98,261 |
| Total | XX | [r]170,991 | XX | 199,409 | XX | 241,701 |
| **MASSACHUSETTS** | | | | | | |
| Clays thousand short tons | 210 | $1,115 | 237 | $1,298 | 240 | $1,212 |
| Lime do. | 135 | 9,414 | 156 | 10,671 | 171 | 12,426 |
| Sand and gravel: | | | | | | |
| Construction do. | 12,003 | 34,438 | [e]10,400 | [e]36,200 | 14,168 | 42,139 |
| Industrial do. | 140 | 1,615 | W | W | W | W |
| Stone: | | | | | | |
| Crushed do. | [e]6,900 | [e]33,500 | 7,740 | 36,002 | [e]8,400 | [e]39,000 |
| Dimension do. | [r] [e]55 | [r] [e]11,399 | 51 | 10,488 | [e]57 | [e]11,657 |
| Combined value of gem stones, peat, and values indicated by symbol W | XX | 62 | XX | 1,016 | XX | 898 |
| Total | XX | [r]91,543 | XX | 95,675 | XX | 107,332 |
| **MICHIGAN** | | | | | | |
| Cement: | | | | | | |
| Masonry thousand short tons | 136 | $8,752 | W | W | W | W |
| Portland do. | 3,254 | 149,533 | W | W | W | W |
| Clays do. | 1,022 | 4,370 | 1,199 | $5,693 | 1,321 | $5,052 |
| Gem stones | NA | 15 | NA | 15 | NA | 15 |
| Gypsum thousand short tons | 682 | 5,150 | 1,097 | 8,104 | 1,534 | 10,304 |
| Iron ore (usable) thousand long tons, gross weight | W | W | 10,713 | W | 13,263 | W |
| Lime thousand short tons | 571 | 26,823 | 503 | 23,142 | 622 | 30,092 |
| Peat do. | 241 | 4,917 | 215 | 4,286 | 227 | 4,341 |
| Salt do. | 2,002 | 106,303 | 1,355 | 93,306 | 1,491 | 93,860 |
| Sand and gravel: | | | | | | |
| Construction do. | 20,567 | 47,726 | [e]23,000 | [e]52,300 | 36,071 | 76,540 |
| Industrial do. | 2,920 | 21,934 | 3,545 | 27,577 | 3,400 | 33,060 |
| Stone: | | | | | | |
| Crushed do. | [e]20,700 | [e]67,100 | 24,763 | 82,152 | [e]28,100 | [e]92,000 |
| Dimension do. | [e]4 | [r] [e]95 | 4 | 112 | [e]4 | [e]129 |
| Combined value of bromine, calcium chloride, copper (1982), iodine, iron oxide pigments (crude), magnesium compounds, silver (1982), and values indicated by symbol W | XX | 592,451 | XX | [r]882,239 | XX | 1,063,214 |
| Total | XX | [r]1,035,169 | XX | [r]1,178,926 | XX | 1,408,607 |
| **MINNESOTA** | | | | | | |
| Gem stones | NA | $5 | NA | $5 | NA | $5 |
| Iron ore (usable) thousand long tons, gross weight | 23,715 | 1,021,056 | 30,699 | 1,342,455 | 35,602 | 1,561,516 |
| Lime thousand short tons | 133 | 4,694 | W | W | W | W |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **MINNESOTA—Continued** |  |  |  |  |  |  |
| Manganiferous ore short tons | 16,307 | W | 11,314 | W | 68,019 | W |
| Peat thousand short tons | W | W | W | W | 24 | W |
| Sand and gravel: |  |  |  |  |  |  |
| Construction do | 20,276 | $44,222 | [e]24,600 | [e]$53,000 | 22,612 | $49,087 |
| Industrial do | 694 | 5,903 | 685 | 12,932 | W | W |
| Stone: |  |  |  |  |  |  |
| Crushed do | [e]7,100 | [e]20,900 | 8,580 | 25,320 | [e]8,900 | [e]25,800 |
| Dimension do | [r] [e]29 | [r] [e]10,956 | 28 | 11,365 | [e]39 | [e]13,369 |
| Combined values of clays and values indicated by symbol W | XX | 1,406 | XX | 9,953 | XX | 26,470 |
| Total | XX | [r]1,109,142 | XX | 1,455,030 | XX | 1,676,247 |
| **MISSISSIPPI** |  |  |  |  |  |  |
| Clays thousand short tons | 805 | $21,181 | 1,446 | $23,846 | 2,398 | $30,565 |
| Sand and gravel (construction) do | 9,455 | 27,115 | [e]11,000 | [e]34,600 | 12,205 | 34,955 |
| Stone (crushed) do | W | W | 1,651 | 4,377 | [e]2,000 | [e]5,800 |
| Combined value of cement, sand and gravel (industrial), and value indicated by symbol W | XX | 24,389 | XX | 26,882 | XX | 22,858 |
| Total | XX | 72,685 | XX | 89,705 | XX | 94,178 |
| **MISSOURI** |  |  |  |  |  |  |
| Barite thousand short tons | 107 | $5,703 | W | W | W | W |
| Cement: |  |  |  |  |  |  |
| Masonry do | 88 | 4,855 | 146 | $7,339 | 143 | $7,033 |
| Portland do | 3,205 | 120,339 | 3,499 | 157,249 | 3,981 | 178,225 |
| Clays[2] do | 1,383 | 13,409 | 1,418 | 11,848 | 1,575 | 14,666 |
| Copper (recoverable content of ores, etc.) metric tons | 7,941 | 12,745 | 7,725 | 13,033 | 5,818 | 8,575 |
| Gem stones | NA | 10 | NA | 10 | NA | 10 |
| Iron ore thousand long tons | 717 | W | 877 | 27,054 | 1,370 | W |
| Lead (recoverable content of ores, etc.) metric tons | 474,460 | 267,150 | 409,280 | 195,620 | 278,329 | 156,766 |
| Sand and gravel: |  |  |  |  |  |  |
| Construction thousand short tons | 6,359 | 14,477 | [e]7,700 | [e]17,700 | 7,967 | 19,364 |
| Industrial do | 750 | 8,997 | 600 | 7,541 | 614 | 8,129 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 2,241 | 17,817 | 2,021 | 23,124 | 1,401 | 11,406 |
| Stone: |  |  |  |  |  |  |
| Crushed thousand short tons | [e]38,600 | [e]113,300 | 39,454 | 120,700 | [e]41,600 | [e]137,000 |
| Dimension do | [e](3) | [e]13 | W | W | W | W |
| Zinc (recoverable content of ores, etc.) metric tons | 63,680 | 54,009 | 57,044 | 52,052 | 45,458 | 48,707 |
| Combined value of clays (fuller's earth and kaolin, 1984), iron oxide pigments (crude), lime, stone (dimension), and values indicated by symbol W | XX | [r]100,032 | XX | [r]92,598 | XX | 142,016 |
| Total | XX | [r]732,856 | XX | [r]725,868 | XX | 731,897 |
| **MONTANA** |  |  |  |  |  |  |
| Antimony short tons | 209 | W | 253 | W | -- | -- |
| Barite thousand short tons | W | W | 10 | $750 | W | W |
| Clays do | [2]218 | [2]$8,064 | 194 | 6,205 | 397 | $15,260 |
| Copper (recoverable content of ores, etc.) metric tons | 64,951 | 104,245 | 33,337 | 56,245 | W | W |
| Gem stones | NA | 225 | NA | 300 | NA | 450 |
| Gold (recoverable content of ores, etc.) troy ounces | 75,171 | 28,258 | 161,436 | 68,449 | 181,190 | 65,348 |
| Lead (recoverable content of ores, etc.) metric tons | 661 | 372 | 1,163 | 556 | W | W |
| Lime thousand short tons | 45 | 2,331 | 86 | W | 89 | 5,097 |
| Sand and gravel (construction) do | 5,338 | 12,794 | [e]5,000 | [e]10,200 | 7,776 | 21,269 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 6,169 | 49,041 | 5,708 | 65,299 | 5,653 | 46,018 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| | | | **MONTANA—Continued** | | | |
| Stone (crushed) thousand short tons | $^{e}$1,400 | $^{e}$\$4,700 | 872 | $^{r}$\$2,320 | $^{e}$950 | $^{e}$\$2,400 |
| Zinc (recoverable content of ores, etc.) metric tons | W | W | -- | -- | -- | -- |
| Combined value of cement, clays (fire clay, 1982), graphite, gypsum, iron ore, molybdenum (1983), peat, phosphate rock, sand and gravel (industrial), stone (dimension), talc, tungsten ore and concentrate (1982), vermiculite, and values indicated by symbol W | XX | $^{r}$60,701 | XX | $^{r}$81,644 | XX | 93,521 |
| Total | XX | $^{r}$270,731 | XX | $^{r}$291,968 | XX | 249,363 |
| | | | **NEBRASKA** | | | |
| Clays thousand short tons | 134 | \$392 | 164 | \$501 | 180 | \$556 |
| Sand and gravel: | | | | | | |
| Construction do | 9,713 | 23,851 | $^{e}$10,100 | $^{e}$25,000 | 11,839 | 27,791 |
| Industrial do | 14 | 105 | 4 | W | W | W |
| Stone (crushed) do | $^{e}$3,100 | $^{e}$14,300 | $^{r}$4,442 | $^{r}$22,612 | $^{e}$4,500 | $^{e}$23,400 |
| Combined value of cement, gem stones, lime, and values indicated by symbol W | XX | 36,632 | XX | 39,296 | XX | 48,621 |
| Total | XX | 75,280 | XX | $^{r}$87,409 | XX | 100,368 |
| | | | **NEVADA** | | | |
| Barite thousand short tons | 1,575 | \$52,727 | 663 | \$21,736 | 615 | \$14,924 |
| Clays do | 103 | 2,640 | 58 | 2,348 | [2]20 | [2]1,191 |
| Gem stones | NA | 1,200 | NA | 1,200 | NA | 1,300 |
| Gold (recoverable content of ores, etc.) troy ounces | 757,099 | 284,601 | $^{r}$914,531 | $^{r}$387,761 | 997,508 | 359,759 |
| Gypsum thousand short tons | 656 | 4,523 | 998 | 7,896 | 1,192 | 8,860 |
| Iron ore thousand long tons | 77 | 1,119 | W | W | W | W |
| Lead (recoverable content of ores, etc.) metric tons | W | W | 14 | 7 | W | W |
| Mercury 76-pound flasks | 25,760 | W | 25,070 | W | 19,048 | W |
| Sand and gravel: | | | | | | |
| Construction thousand short tons | 6,027 | 11,724 | $^{e}$7,500 | $^{e}$16,200 | 8,202 | 20,505 |
| Industrial do | W | W | W | W | 489 | W |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 3,142 | 24,981 | 5,164 | 59,073 | 6,477 | 52,727 |
| Stone (crushed) thousand short tons | $^{e}$1,300 | $^{e}$4,500 | 1,269 | 5,358 | $^{e}$1,100 | $^{e}$4,700 |
| Combined value of cement (portland), clays (fuller's earth and kaolin, 1984), copper, diatomite, fluorspar, lime, lithium, magnesite, molybdenum, perlite, salt, tungsten ore and concentrate (1982 and 1984), and values indicated by symbol W | XX | 144,448 | XX | $^{r}$111,178 | XX | 151,787 |
| Total | XX | 532,463 | XX | $^{r}$612,757 | XX | 615,753 |
| | | | **NEW HAMPSHIRE** | | | |
| Sand and gravel (construction) thousand short tons | 4,332 | \$12,593 | $^{e}$4,000 | $^{e}$\$12,100 | 5,637 | \$16,054 |
| Stone: | | | | | | |
| Crushed do | $^{e}$600 | $^{e}$3,100 | 946 | 2,853 | $^{e}$850 | $^{e}$2,700 |
| Dimension do | $^{r\ e}$55 | $^{r\ e}$3,593 | 58 | 4,032 | $^{e}$59 | $^{e}$4,198 |
| Combined value of other nonmetals | XX | 101 | XX | 101 | XX | 160 |
| Total | XX | $^{r}$19,387 | XX | 19,086 | XX | 23,112 |
| | | | **NEW JERSEY** | | | |
| Clays thousand short tons | 63 | \$566 | 62 | \$596 | 61 | \$611 |
| Gem stones | NA | 1 | NA | 1 | NA | 1 |
| Peat thousand short tons | W | W | W | W | 5 | 128 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **NEW JERSEY—Continued** |  |  |  |  |  |  |
| Sand and gravel: |  |  |  |  |  |  |
| Construction thousand short tons | 7,940 | $25,722 | $^{e}$10,800 | $^{e}$$34,300 | 9,545 | $31,878 |
| Industrial do. | 2,140 | 28,151 | 2,386 | 31,819 | 2,712 | 32,287 |
| Stone (crushed) do. | $^{e}$10,700 | $^{e}$57,800 | 12,301 | 70,421 | $^{e}$13,500 | $^{e}$75,000 |
| Zinc (recoverable content of ores, etc.) metric tons | 16,800 | 14,248 | 16,475 | 15,033 | W | W |
| Combined value of magnesium compounds (1982-83), marl (greensand), stone (dimension), titanium concentrate (ilmenite, 1982), and values indicated by symbol W | XX | $^{r}$5,845 | XX | 2,445 | XX | 16,331 |
| Total | XX | $^{r}$132,333 | XX | 154,615 | XX | 156,236 |
| **NEW MEXICO** |  |  |  |  |  |  |
| Clays thousand short tons | [2]60 | [2]$112 | 50 | $115 | 67 | $143 |
| Gem stones | NA | 200 | NA | 200 | NA | 200 |
| Gypsum thousand short tons | 198 | 887 | 169 | 1,016 | 318 | 1,622 |
| Lead (recoverable content of ores, etc.) metric tons | W | W | 258 | 123 | -- | -- |
| Lime thousand short tons | W | W | 17 | W | -- | -- |
| Perlite do. | 408 | 13,355 | 394 | 13,297 | 416 | 14,115 |
| Potassium salts thousand metric tons | 1,497 | 204,600 | 1,278 | 174,700 | 1,418 | 204,100 |
| Pumice thousand short tons | 97 | 809 | 110 | 1,070 | 132 | 1,269 |
| Sand and gravel (construction) do. | 5,616 | 17,670 | $^{e}$7,000 | $^{e}$20,000 | 8,363 | 22,389 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 805 | 6,397 | W | W | W | W |
| Stone: |  |  |  |  |  |  |
| Crushed thousand short tons | $^{e}$2,800 | $^{e}$13,700 | 4,730 | $^{r}$15,118 | $^{e}$4,700 | $^{e}$17,000 |
| Dimension do. | $^{e}$18 | $^{r\ e}$141 | 18 | 141 | $^{e}$19 | $^{e}$149 |
| Combined value of carbon dioxide (1982), cement, clays (fire clay, 1982), copper, gold, helium (Grade-A), mica (scrap), molybdenum, salt, sand and gravel (industrial, 1982), tungsten ore and concentrate (1984), and values indicated by symbol W | XX | 171,432 | XX | 291,411 | XX | 358,157 |
| Total | XX | $^{r}$429,303 | XX | $^{r}$517,191 | XX | 619,144 |
| **NEW YORK** |  |  |  |  |  |  |
| Clays[2] thousand short tons | 352 | $897 | 371 | $869 | 543 | $2,435 |
| Gem stones | NA | 30 | NA | 30 | NA | 30 |
| Lead (recoverable content of ores, etc.) metric tons | 1,065 | 600 | 1,299 | 621 | W | W |
| Peat thousand short tons | W | W | 18 | W | W | W |
| Salt do. | 6,205 | 117,718 | 4,859 | 100,119 | 5,644 | 123,755 |
| Sand and gravel: |  |  |  |  |  |  |
| Construction do. | 17,338 | 46,871 | $^{e}$18,700 | $^{e}$54,200 | 25,968 | 80,866 |
| Industrial do. | 45 | 512 | W | W | 25 | 260 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 27 | 216 | 33 | 379 | W | W |
| Stone: |  |  |  |  |  |  |
| Crushed thousand short tons | $^{e}$28,700 | $^{e}$132,800 | $^{r}$31,991 | $^{r}$134,752 | $^{e}$33,100 | $^{e}$135,000 |
| Dimension do. | $^{e}$22 | $^{r\ e}$3,952 | 24 | 4,310 | $^{e}$15 | $^{e}$4,271 |
| Zinc (recoverable content of ores, etc.) metric tons | 52,237 | 44,303 | 56,748 | 51,783 | W | W |
| Combined value of cement, clays (ball clay), emery, garnet (abrasive), gypsum, iron ore (1982), lime, talc, titanium concentrate (ilmenite), wollastonite, and values indicated by symbol W | XX | 155,959 | XX | 156,351 | XX | 265,873 |
| Total | XX | $^{r}$503,858 | XX | $^{r}$503,414 | XX | 612,490 |

See footnotes at end of table.

### Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **NORTH CAROLINA** |  |  |  |  |  |  |
| Clays ---------- thousand short tons-- | [2]1,573 | [2]$5,243 | [2]2,068 | [2]$6,681 | 2,327 | $8,987 |
| Feldspar ----------------short tons-- | 428,755 | 12,255 | 508,641 | 13,610 | 510,275 | 13,994 |
| Gem stones------------------------ | NA | 50 | NA | 50 | NA | 50 |
| Mica (scrap) ----- thousand short tons-- | 67 | 4,793 | 69 | 4,266 | 79 | 3,762 |
| Sand and gravel: |  |  |  |  |  |  |
| Construction---------------do---- | 5,198 | 15,395 | [e]5,600 | [e]16,900 | 6,312 | 18,159 |
| Industrial ---------------do---- | 716 | 4,878 | 1,066 | 11,689 | 1,158 | 12,864 |
| Stone: |  |  |  |  |  |  |
| Crushed-----------------do---- | [e]27,500 | [e]117,600 | 33,694 | [r]145,001 | [e]38,100 | [e]168,000 |
| Dimension ---------------do---- | [r] [e]165 | [r] [e]8,457 | 87 | 8,267 | W | W |
| Talc and pyrophyllite ----------do---- | 83 | 1,266 | 89 | 1,452 | 87 | 1,587 |
| Combined value of cement, clays (kaolin, 1982-83), lithium compounds, olivine, peat, phosphate rock, and value indicated by symbol W --------------------- | XX | 135,142 | XX | 190,641 | XX | 224,077 |
| Total--------------------- | XX | [r]305,079 | XX | [r]398,557 | XX | 451,480 |
| **NORTH DAKOTA** |  |  |  |  |  |  |
| Gem stones------------------------ | NA | $2 | NA | $2 | NA | $2 |
| Lime ---------- thousand short tons-- | W | W | 57 | 6,798 | 60 | 5,912 |
| Sand and gravel (construction)----do---- | 2,347 | 4,873 | [e]3,800 | [e]15,000 | 6,426 | 11,351 |
| Combined value of clays, peat, salt, and value indicated by symbol W ------------- | XX | 8,102 | XX | 3,570 | XX | 4,529 |
| Total--------------------- | XX | 12,977 | XX | 25,370 | XX | 21,794 |
| **OHIO** |  |  |  |  |  |  |
| Cement: |  |  |  |  |  |  |
| Masonry ----- thousand short tons-- | 86 | $6,170 | 97 | $7,454 | 101 | $8,092 |
| Portland -----------------do---- | 1,326 | 59,598 | 1,575 | 71,599 | 1,525 | 69,810 |
| Clays ---------------------do---- | 1,451 | 6,100 | 1,716 | 8,061 | 1,960 | 10,473 |
| Gypsum--------------------do---- | 109 | 1,335 | W | W | W | W |
| Lime ----------------------do---- | 1,666 | 76,370 | 1,906 | 84,928 | 1,859 | 87,951 |
| Peat-----------------------do---- | 5 | 144 | W | W | 13 | 345 |
| Salt ----------------------do---- | 3,514 | 90,572 | 2,565 | 85,988 | W | W |
| Sand and gravel: |  |  |  |  |  |  |
| Construction---------------do---- | 26,160 | 83,015 | [e]27,200 | [e]84,600 | 31,748 | 104,709 |
| Industrial ---------------do---- | 1,223 | 17,816 | 1,226 | 17,848 | 1,506 | 20,829 |
| Stone: |  |  |  |  |  |  |
| Crushed-----------------do---- | [e]30,300 | [e]105,200 | 32,937 | 114,059 | [e]38,500 | [e]139,000 |
| Dimension ---------------do---- | [r] [e]48 | [r] [e]2,765 | 49 | 2,923 | [e]37 | [e]3,454 |
| Combined value of abrasives, gem stones, and values indicated by symbol W -------- | XX | [r]35 | XX | 1,684 | XX | 108,240 |
| Total--------------------- | XX | [r]449,120 | XX | 479,144 | XX | 552,903 |
| **OKLAHOMA** |  |  |  |  |  |  |
| Cement: |  |  |  |  |  |  |
| Masonry ----- thousand short tons-- | W | W | 45 | $3,074 | 49 | $3,506 |
| Portland -----------------do---- | W | W | 1,719 | 83,685 | 1,732 | 84,701 |
| Clays ---------------------do---- | 752 | $1,907 | 862 | 2,288 | 979 | 2,498 |
| Gem stones------------------------ | NA | 2 | NA | 2 | NA | 2 |
| Gypsum-------- thousand short tons-- | 1,254 | 10,089 | 1,351 | 11,571 | 1,549 | 13,485 |
| Pumice --------------------do---- | 1 | W | 1 | W | W | W |
| Sand and gravel: |  |  |  |  |  |  |
| Construction---------------do---- | 7,490 | 17,733 | [e]7,500 | [e]17,300 | 10,984 | 26,582 |
| Industrial ---------------do---- | 1,222 | 13,114 | 1,184 | 13,221 | W | W |
| Stone: |  |  |  |  |  |  |
| Crushed-----------------do---- | [e]30,100 | [e]84,200 | 23,865 | 76,941 | [e]25,500 | [e]86,000 |
| Dimension ---------------do---- | [r] [e]8 | [r] [e]589 | 10 | 737 | [e]12 | [e]771 |
| Combined value of feldspar, iodine, lime, salt, tripoli, and values indicated by symbol W - | XX | 97,031 | XX | 17,367 | XX | 28,187 |
| Total--------------------- | XX | [r]224,665 | XX | 226,186 | XX | 245,732 |

See footnotes at end of table.

### Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **OREGON** | | | | | | |
| Clays thousand short tons | 149 | $212 | 188 | $275 | 189 | $288 |
| Gem stones | NA | 500 | NA | 600 | NA | 400 |
| Gold (recoverable content of ores, etc.) troy ounces | W | W | 322 | 137 | W | W |
| Nickel (content of ores and concentrates) short tons | 3,203 | W | -- | -- | 14,540 | W |
| Sand and gravel (construction) thousand short tons | 9,513 | 30,629 | $^{e}$11,000 | $^{e}$37,000 | 12,776 | 37,117 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | -- | -- | 1 | 10 | W | W |
| Stone (crushed) thousand short tons | $^{e}$14,200 | $^{e}$41,900 | 13,089 | $^{r}$39,873 | $^{e}$12,500 | $^{e}$37,500 |
| Talc and soapstone do. | (3) | 82 | (3) | 123 | (3) | 66 |
| Combined value of cement, copper (1983), diatomite, lead (1983), lime, pumice, sand and gravel (industrial, 1983), stone (dimension, 1982-83), and values indicated by symbol W | XX | $^{r}$34,517 | XX | 32,922 | XX | 45,031 |
| Total | XX | $^{r}$107,840 | XX | $^{r}$110,940 | XX | 120,402 |
| **PENNSYLVANIA** | | | | | | |
| Cement: | | | | | | |
| Masonry thousand short tons | 256 | $14,048 | 262 | $17,095 | 298 | $20,849 |
| Portland do. | 4,800 | 212,945 | 5,154 | 218,539 | 5,735 | 281,590 |
| Clays[2] do. | 931 | 5,616 | 916 | 4,311 | 963 | 4,050 |
| Gem stones | NA | 5 | NA | 5 | NA | 5 |
| Lime thousand short tons | 1,297 | 70,902 | 1,507 | 81,682 | 1,620 | 90,182 |
| Peat do. | 27 | 669 | 22 | 628 | 24 | 693 |
| Sand and gravel: | | | | | | |
| Construction do. | 13,081 | 55,527 | $^{e}$11,800 | $^{e}$52,000 | 14,472 | 64,285 |
| Industrial do. | 969 | 13,589 | W | W | W | W |
| Stone: | | | | | | |
| Crushed do. | $^{e}$50,400 | $^{e}$200,900 | 51,523 | 226,948 | $^{e}$56,200 | $^{e}$228,000 |
| Dimension do. | $^{r\ e}$42 | $^{r\ e}$5,033 | 53 | 5,799 | $^{e}$44 | $^{e}$6,001 |
| Zinc (recoverable content of ores, etc.) metric tons | 24,762 | 21,001 | 16,792 | 15,322 | -- | -- |
| Combined value of clays (kaolin), mica (scrap), tripoli (1982), and values indicated by symbol W | XX | 1,094 | XX | 12,812 | XX | 12,701 |
| Total | XX | $^{r}$601,329 | XX | 635,141 | XX | 708,356 |
| **RHODE ISLAND** | | | | | | |
| Sand and gravel: | | | | | | |
| Construction thousand short tons | 1,146 | $3,671 | $^{e}$1,000 | $^{e}$$2,400 | 1,483 | $5,282 |
| Industrial do. | 5 | 52 | -- | -- | W | W |
| Stone (crushed) do. | $^{e}$130 | $^{e}$1,100 | 971 | 5,507 | $^{e}$1,000 | $^{e}$5,800 |
| Combined value of other nonmetals and value indicated by symbol W | XX | $^{r}$25 | XX | 23 | XX | 486 |
| Total | XX | $^{r}$4,848 | XX | 7,930 | XX | 11,568 |
| **SOUTH CAROLINA** | | | | | | |
| Cement, portland thousand short tons | 1,624 | $66,385 | W | W | 2,319 | $103,891 |
| Clays[2] do. | 1,535 | 28,166 | 1,813 | $34,830 | 1,834 | 36,809 |
| Gem stones | NA | 10 | NA | 10 | NA | 10 |
| Manganiferous ore thousand short tons | 15 | W | 22 | W | 20 | W |
| Peat do. | 5 | W | W | W | 5 | W |
| Sand and gravel: | | | | | | |
| Construction do. | 4,727 | 13,170 | $^{e}$5,200 | $^{e}$15,000 | 5,845 | 17,097 |
| Industrial do. | 720 | 10,902 | 842 | 13,169 | 882 | 14,889 |
| Stone: | | | | | | |
| Crushed do. | $^{e}$14,000 | $^{e}$53,000 | 15,786 | 61,054 | $^{e}$17,900 | $^{e}$72,500 |
| Dimension do. | $^{r\ e}$17 | $^{r\ e}$1,164 | 17 | 1,165 | $^{e}$16 | $^{e}$1,092 |
| Combined value of cement (masonry), clays (fuller's earth), mica (scrap), vermiculite, and values indicated by symbol W | XX | 22,181 | XX | 105,366 | XX | 29,562 |
| Total | XX | $^{r}$194,978 | XX | 230,594 | XX | 275,850 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| SOUTH DAKOTA | | | | | | |
| Cement: | | | | | | |
| Masonry thousand short tons | 4 | $383 | 4 | $359 | 5 | $283 |
| Portland do | 520 | 27,978 | 603 | 37,435 | 619 | 30,773 |
| Clays[2] do | 128 | 346 | 123 | 353 | 119 | 343 |
| Feldspar short tons | W | W | 7,109 | 107 | 7,219 | 124 |
| Gem stones | NA | 70 | NA | 70 | NA | 70 |
| Gold (recoverable content of ores, etc.) troy ounces | 185,038 | 69,558 | 309,784 | 131,348 | 310,527 | 111,994 |
| Sand and gravel (construction) thousand short tons | 3,816 | 8,604 | $^{e}$5,100 | $^{e}$11,500 | 5,786 | 12,168 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 26 | 209 | 62 | 713 | 50 | 407 |
| Stone: | | | | | | |
| Crushed thousand short tons | $^{e}$2,600 | $^{e}$7,400 | 3,906 | 12,982 | $^{e}$3,800 | $^{e}$12,800 |
| Dimension do | $^{r\ e}$39 | $^{r\ e}$14,805 | $^{r}$42 | $^{r}$15,794 | $^{e}$60 | $^{e}$18,642 |
| Combined value of beryllium, clays (bentonite), gypsum, lime, mica (scrap), and value indicated by symbol W | XX | 4,855 | XX | 11,432 | XX | 5,803 |
| Total | XX | $^{r}$134,208 | XX | $^{r}$222,093 | XX | 193,407 |
| TENNESSEE | | | | | | |
| Cement, portland thousand short tons | 763 | $36,689 | W | W | W | W |
| Clays do | 766 | 20,107 | 1,066 | $26,516 | 1,267 | $30,207 |
| Gem stones | NA | 5 | NA | 5 | NA | 5 |
| Phosphate rock thousand metric tons | 897 | 11,596 | 1,193 | $^{r}$29,073 | 1,368 | 33,275 |
| Sand and gravel: | | | | | | |
| Construction thousand short tons | 5,051 | 15,917 | $^{e}$6,100 | $^{e}$18,700 | 6,304 | 19,830 |
| Industrial do | 468 | 4,826 | 483 | 5,455 | 650 | 6,903 |
| Stone: | | | | | | |
| Crushed do | W | W | 30,578 | $^{r}$111,573 | $^{e}$36,200 | $^{e}$138,000 |
| Dimension do | $^{r\ e}$8 | $^{r\ e}$1,238 | 7 | 1,161 | $^{e}$7 | $^{e}$1,097 |
| Zinc (recoverable content of ores, etc.) metric tons | 121,306 | 102,882 | 109,958 | 100,336 | 116,526 | 124,854 |
| Combined value of barite, cement (masonry), copper, lead (1984), lime, pyrites, silver, and values indicated by symbol W | XX | 185,453 | XX | 114,493 | XX | 124,150 |
| Total | XX | $^{r}$378,713 | XX | $^{r}$407,312 | XX | 478,321 |
| TEXAS | | | | | | |
| Cement: | | | | | | |
| Masonry thousand short tons | 236 | $16,440 | 276 | $19,704 | 291 | $24,409 |
| Portland do | 9,732 | 545,679 | 9,760 | 534,298 | 10,423 | 557,421 |
| Clays do | 4,193 | 26,497 | 3,955 | 22,575 | 3,594 | 23,051 |
| Gem stones | NA | 200 | NA | 225 | NA | 175 |
| Gypsum thousand short tons | 1,954 | 16,681 | 2,049 | 16,357 | 2,166 | 19,431 |
| Helium (Grade-A) million cubic feet | 458 | 15,572 | 524 | 18,340 | W | W |
| Lime thousand short tons | 1,125 | 62,277 | 1,067 | 60,193 | 1,157 | 61,214 |
| Salt do | 7,421 | 82,805 | 8,028 | 65,670 | 8,184 | 69,672 |
| Sand and gravel: | | | | | | |
| Construction do | 45,527 | 154,515 | $^{e}$58,500 | $^{e}$208,000 | 62,389 | 199,461 |
| Industrial do | 2,201 | 35,974 | 1,788 | 29,637 | 2,028 | 29,282 |
| Stone: | | | | | | |
| Crushed do | $^{e}$68,000 | $^{e}$205,000 | $^{r}$76,328 | $^{r}$239,187 | $^{e}$89,200 | $^{e}$300,000 |
| Dimension do | $^{r\ e}$41 | $^{r\ e}$7,702 | 50 | 11,071 | $^{e}$47 | $^{e}$11,236 |
| Sulfur (Frasch) thousand metric tons | 2,360 | W | 2,468 | W | 2,994 | W |
| Talc and pyrophyllite thousand short tons | 205 | 3,024 | 250 | 3,933 | 283 | 5,703 |
| Combined value of asphalt (native, 1984), fluorspar, helium (crude), iron ore, magnesium chloride, magnesium compounds, mica (scrap, 1984), sodium sulfate, and values indicated by symbol W | XX | 374,912 | XX | $^{r}$279,291 | XX | 414,352 |
| Total | XX | $^{r}$1,547,278 | XX | $^{r}$1,508,481 | XX | 1,715,407 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **UTAH** | | | | | | |
| Beryllium concentrate short tons | W | W | W | W | 6,030 | $6 |
| Clays[2] thousand short tons | 183 | $994 | 227 | $1,569 | 315 | 2,223 |
| Copper (recoverable content of ores, etc.) metric tons | 189,090 | $^{r}$303,483 | 169,751 | 286,403 | W | W |
| Gem stones | NA | 80 | NA | 80 | NA | 80 |
| Gold (recoverable content of ores, etc.) troy ounces | 174,940 | 65,762 | 238,459 | 101,107 | W | W |
| Gypsum thousand short tons | 231 | 2,363 | 305 | 2,736 | 277 | 2,671 |
| Lime do. | 286 | 15,121 | 315 | 16,771 | 297 | 16,471 |
| Salt do. | 1,227 | 23,210 | 936 | 23,184 | 1,246 | 28,651 |
| Sand and gravel: | | | | | | |
| Construction do. | 7,579 | 14,920 | $^{e}$9,800 | $^{e}$19,800 | 15,217 | 34,507 |
| Industrial do. | W | W | 24 | W | 11 | W |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 4,342 | 34,522 | 4,567 | 52,242 | W | W |
| Stone: | | | | | | |
| Crushed thousand short tons | $^{e}$2,500 | $^{e}$9,800 | 4,407 | 14,636 | $^{e}$5,200 | $^{e}$16,400 |
| Dimension do. | $^{r}$W | $^{r}$W | W | W | -- | -- |
| Combined value of asphalt (native), cement, clays (fuller's earth), iron ore (usable, 1982-83), lead (1982 and 1984), magnesium compounds, molybdenum, perlite (1983), phosphate rock, potassium salts, sodium sulfate, vanadium, zinc (1984), and values indicated by symbol W | XX | $^{r}$145,837 | XX | 138,051 | XX | 423,153 |
| Total | XX | $^{r}$616,092 | XX | 656,579 | XX | 524,162 |
| **VERMONT** | | | | | | |
| Sand and gravel (construction) thousand short tons | 3,218 | $6,854 | $^{e}$3,000 | $^{e}$$6,200 | 3,802 | $8,071 |
| Stone: | | | | | | |
| Crushed do. | $^{e}$1,200 | $^{e}$5,300 | 1,339 | 5,579 | $^{e}$1,800 | $^{e}$7,000 |
| Dimension do. | $^{r\ e}$109 | $^{r\ e}$18,358 | $^{r}$116 | 19,995 | $^{e}$116 | $^{e}$20,462 |
| Combined value of talc and other nonmetals | XX | 8,550 | XX | 10,355 | XX | 9,565 |
| Total | XX | $^{r}$39,062 | XX | 42,129 | XX | 45,098 |
| **VIRGINIA** | | | | | | |
| Clays thousand short tons | 422 | $2,237 | 784 | $5,467 | 712 | $6,004 |
| Gem stones | NA | 20 | NA | 20 | NA | 20 |
| Iron oxide pigments short tons | 1,269 | 372 | W | W | W | W |
| Lime thousand short tons | 641 | 29,118 | 557 | 24,637 | 562 | 24,799 |
| Sand and gravel (construction) do. | 6,978 | 28,522 | $^{e}$7,200 | $^{e}$30,800 | 8,860 | 37,359 |
| Stone: | | | | | | |
| Crushed do. | $^{e}$35,200 | $^{e}$142,300 | 37,959 | $^{r}$159,553 | $^{e}$47,200 | $^{e}$196,000 |
| Dimension do. | $^{e}$4 | $^{r\ e}$1,151 | 93 | $^{r}$2,238 | $^{e}$22 | $^{e}$3,052 |
| Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), talc (soapstone), vermiculite, and values indicated by symbol W | XX | 59,484 | XX | 66,629 | XX | 74,355 |
| Total | XX | $^{r}$263,204 | XX | 289,344 | XX | 341,589 |

See footnotes at end of table.

## Table 5.—Nonfuel mineral production[1] in the United States, by State —Continued

| Mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **WASHINGTON** |  |  |  |  |  |  |
| Cement, portland thousand short tons | 1,154 | $75,988 | W | W | W | W |
| Clays do | 251 | 1,829 | [2]282 | [2]$1,715 | 292 | $1,646 |
| Gem stones | NA | 200 | NA | 200 | NA | 200 |
| Sand and gravel: |  |  |  |  |  |  |
| Construction thousand short tons | 15,190 | 40,295 | [e]15,800 | [e]50,300 | 23,369 | 61,070 |
| Industrial do | 242 | 2,809 | 337 | 4,581 | 356 | 5,201 |
| Stone: |  |  |  |  |  |  |
| Crushed do | [e]8,600 | [e]23,800 | 10,451 | 29,607 | [e]10,400 | [e]31,700 |
| Dimension do | [r] [e]([3]) | [r] [e]20 | 1 | 37 | -- | -- |
| Talc do | 8 | 20 | W | W | W | W |
| Combined value of barite, clays (fire clay, 1983), cement (masonry), diatomite, gold, gypsum, lead (1982), lime, olivine, peat, silver, and values indicated by symbol W | XX | 24,766 | XX | 101,025 | XX | 102,807 |
| Total | XX | [r]169,727 | XX | 187,465 | XX | 202,624 |
| **WEST VIRGINIA** |  |  |  |  |  |  |
| Clays thousand short tons | [2]210 | [2]$583 | [2]249 | [2]$532 | 381 | $3,410 |
| Salt do | 942 | W | 1,026 | W | 1,004 | W |
| Sand and gravel (construction) do | 751 | 3,392 | [e]700 | [e]3,400 | 976 | 3,198 |
| Stone (crushed) do | [e]5,900 | [e]22,700 | 9,439 | 37,962 | [e]9,100 | [e]37,300 |
| Combined value of cement, clays (fire clay, 1982-83), lime, sand and gravel (industrial), and values indicated by symbol W | XX | 48,945 | XX | 62,079 | XX | 68,279 |
| Total | XX | 75,620 | XX | 103,973 | XX | 112,187 |
| **WISCONSIN** |  |  |  |  |  |  |
| Iron ore (usable) thousand long tons, gross weight | 263 | W | -- | -- | -- | -- |
| Lime thousand short tons | 312 | $17,685 | 319 | $17,624 | 373 | $19,892 |
| Peat do | 9 | W | 9 | W | 9 | W |
| Sand and gravel: |  |  |  |  |  |  |
| Construction do | 14,515 | 29,218 | [e]14,200 | [e]28,800 | 17,785 | 38,245 |
| Industrial do | 788 | 9,662 | 621 | 7,208 | 1,060 | 11,821 |
| Stone: |  |  |  |  |  |  |
| Crushed do | [e]11,400 | [e]36,100 | 14,252 | 39,896 | [e]15,800 | [e]45,000 |
| Dimension do | [r] [e]18 | [r] [e]2,815 | 24 | 2,884 | [e]24 | [e]2,863 |
| Combined value of abrasive stone, cement, and values indicated by symbol W | XX | 16,400 | XX | 4,779 | XX | 11,527 |
| Total | XX | [r]111,880 | XX | 101,191 | XX | 129,348 |
| **WYOMING** |  |  |  |  |  |  |
| Clays thousand short tons | 2,561 | $73,696 | 2,140 | $49,059 | 2,397 | $67,290 |
| Gem stones | NA | 250 | NA | 250 | NA | 225 |
| Gypsum thousand short tons | 283 | 2,805 | 382 | 2,963 | 376 | 2,618 |
| Sand and gravel (construction) do | 3,382 | 10,279 | [e]2,400 | [e]8,000 | 4,586 | 13,372 |
| Stone (crushed) do | [e]2,300 | [e]7,300 | 2,019 | 7,769 | [e]1,900 | [e]7,600 |
| Combined value of beryllium concentrate (1982-83), cement (portland), iron ore (1982-83), lime, and sodium carbonate | XX | 573,865 | XX | 561,860 | XX | 458,187 |
| Total | XX | 668,195 | XX | 629,901 | XX | 549,292 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes certain clays; value included in "Combined value" figure.

[3] Less than 1/2 unit.

[4] Partial total, excludes the values of magnesium compounds, which must be concealed to avoid disclosing company proprietary data.

[5] Excludes bentonite and fire clay.

[6] Excludes salt in brines; value included in "Combined value" figure.

## Table 6.—Mineral production[1] in the islands administered by the United States

(Thousand short tons and thousand dollars)

| Area and mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value | Quantity | Value | Quantity | Value |
| American Samoa: Stone | NA | NA | NA | NA | NA | NA |
| Guam: Stone | NA | NA | 329 | 2,192 | [e]345 | [e]2,280 |
| Virgin Islands: Stone | NA | NA | 237 | 2,305 | [e]249 | [e]2,397 |

[e] Estimated. NA Not available.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 7.—Mineral production[1] in the Commonwealth of Puerto Rico

(Thousand short tons and thousand dollars)

| Mineral | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value | Quantity | Value | Quantity | Value |
| Cement (portland) | 986 | 81,822 | 931 | 82,509 | 997 | 87,568 |
| Clays | 162 | 298 | 125 | 251 | 128 | 266 |
| Lime | 37 | 1,906 | 35 | 3,885 | 35 | 4,531 |
| Sand and gravel | NA | NA | NA | NA | 43 | W |
| Stone: |  |  |  |  |  |  |
| Crushed | NA | NA | 5,536 | 26,611 | [e]5,813 | [e]27,675 |
| Dimension | [r] [e]10 | [r] [e]130 | W | W | [e]35 | [e]455 |
| Total[2] | XX | [r]84,156 | XX | 113,256 | XX | 120,495 |

[e] Estimated. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; not included in "Total." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Total does not include value of items not available.

## Table 8.—U.S. exports of principal minerals and products, excluding mineral fuels

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| **METALS** |  |  |  |  |
| Aluminum: |  |  |  |  |
| Ingots, slabs, crude metric tons | 360,704 | $534,048 | 259,598 | $396,798 |
| Scrap do. | 237,827 | 249,156 | 258,404 | 275,686 |
| Plates, sheets, bars, etc. do. | 162,294 | 388,679 | 198,399 | 496,841 |
| Castings and forgings do. | 9,518 | 55,346 | 11,590 | 69,845 |
| Aluminum sulfate do. | 14,094 | 1,593 | 2,789 | 1,185 |
| Other aluminum compounds do. | 49,706 | 36,447 | 37,616 | 31,700 |
| Antimony, metals and alloys, crude short tons | 304 | 1,039 | 511 | 915 |
| Bauxite including bauxite concentrate thousand metric tons | 74 | 10,561 | 82 | 12,735 |
| Beryllium pounds | 37,477 | 2,693 | 39,315 | 2,562 |
| Bismuth, metals and alloys do. | 306,128 | 703 | 311,511 | 1,091 |
| Cadmium metal metric tons | 170 | 351 | 106 | 208 |
| Chromium: |  |  |  |  |
| Ore and concentrate: |  |  |  |  |
| Exports thousand short tons | 11 | 1,874 | 55 | 2,957 |
| Reexports do. | 5 | 1,350 | 4 | 864 |
| Ferrochromium do. | 4 | 4,822 | 15 | 10,542 |
| Cobalt (content) thousand pounds | [r]757 | 5,715 | 670 | 7,661 |
| Copper: |  |  |  |  |
| Ore, concentrate, composition metal, unrefined (copper content) metric tons | 57,126 | 67,759 | 74,528 | 91,558 |
| Scrap do. | 47,986 | 66,929 | 80,810 | 96,266 |
| Refined copper and semimanufactures do. | 157,664 | 532,595 | 135,885 | 351,999 |
| Other copper manufactures do. | [r]11,281 | [r]30,893 | 13,817 | 30,438 |
| Ferroalloys not elsewhere listed: |  |  |  |  |
| Ferrophosphorus short tons | 26,933 | 3,716 | 39,603 | 5,279 |
| Ferroalloys, n.e.c do. | 5,775 | 7,965 | 27,485 | 16,158 |
| Gold: |  |  |  |  |
| Ore and base bullion troy ounces | 1,257,800 | 501,016 | 1,498,617 | 528,284 |
| Bullion, refined do. | 1,881,233 | 825,418 | 3,482,473 | 1,284,718 |
| Iron ore thousand long tons | 3,781 | 182,744 | 4,993 | 239,257 |

See footnotes at end of table.

## Table 8.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| METALS —Continued | | | | |
| Iron and steel: | | | | |
| Pig iron short tons | 6,364 | $528 | 56,674 | $5,685 |
| Iron and steel products (major): | | | | |
| Steel mill products do | 1,198,623 | 1,054,794 | 977,284 | 904,011 |
| Other steel products do | 246,642 | 553,894 | 261,246 | 513,942 |
| Iron and steel scrap: Ferrous scrap including rerolling materials, ships, boats, other vessels for scrapping thousand short tons | 7,752 | 650,540 | 9,840 | 938,402 |
| Lead: | | | | |
| Ore and concentrate metric tons | 20,119 | 7,502 | 11,858 | 4,760 |
| Pigs, bars, anodes, sheets, etc do | 20,449 | 19,090 | 7,445 | 15,214 |
| Scrap do | 50,918 | 13,139 | 45,097 | 11,575 |
| Magnesium, metal and alloys, scrap, semimanufactured forms, n.e.c short tons | 46,690 | 124,714 | 48,337 | 136,661 |
| Manganese: | | | | |
| Ore and concentrate do | 19,314 | 1,972 | 237,606 | 15,643 |
| Ferromanganese do | 8,433 | 5,765 | 6,764 | 4,397 |
| Silicomanganese do | 6,426 | 1,746 | 5,333 | 2,237 |
| Metal do | 6,391 | 8,531 | 4,082 | 5,915 |
| Molybdenum: | | | | |
| Ore and concentrate (molybdenum content) thousand pounds | 47,068 | 185,122 | 63,366 | 242,770 |
| Metal and alloys, crude and scrap do | 577 | 1,860 | 306 | 1,209 |
| Wire do | 610 | 7,085 | 474 | 5,954 |
| Semimanufactured forms, n.e.c do | 216 | 4,589 | 257 | 6,368 |
| Powder do | 396 | 2,737 | 461 | 3,272 |
| Ferromolybdenum do | 171 | 687 | 650 | 1,567 |
| Compounds do | 8,597 | 22,158 | 26,602 | 56,453 |
| Nickel: | | | | |
| Alloys and scrap including unwrought metal, ingots, bars, sheets, anodes, etc short tons | 38,344 | 154,536 | 44,590 | 199,108 |
| Catalysts do | 3,165 | 13,940 | 2,718 | 15,156 |
| Wire do | 1,039 | 8,831 | 1,119 | 11,166 |
| Semifabricated forms, n.e.c do | 1,365 | 14,420 | 2,218 | 19,991 |
| Platinum-group metals: | | | | |
| Ore and scrap troy ounces | 782,967 | 193,463 | 565,543 | 123,349 |
| Palladium, rhodium, iridium, osmiridium, ruthenium, osmium (metal and alloys including scrap) do | 261,188 | 45,799 | 375,802 | 74,748 |
| Platinum (metal and alloys) do | 184,599 | 70,652 | 220,885 | 76,749 |
| Rare-earth metals: Ferrocerium and alloys short tons | 73 | 393 | 34 | 309 |
| Selenium kilograms | 93,369 | 771 | 122,929 | 1,587 |
| Silicon: | | | | |
| Ferrosilicon short tons | 11,338 | 10,712 | 29,364 | 21,185 |
| Silicon carbide, crude and in grains (including reexports) do | 5,590 | 7,164 | 6,023 | 8,613 |
| Silver: | | | | |
| Ore, concentrate, waste, sweepings thousand troy ounces | 18,294 | 208,066 | 14,108 | 119,965 |
| Bullion, refined do | 13,658 | 169,383 | 10,340 | 86,339 |
| Tantalum: | | | | |
| Ore, metal, other forms thousand pounds | 332 | [r]13,994 | 508 | 24,603 |
| Powder do | 123 | 14,397 | 151 | 17,026 |
| Tin: | | | | |
| Ingots, pigs, bars, etc metric tons | 1,340 | 17,305 | 1,429 | 14,409 |
| Tinplate and terneplate do | 171,121 | 83,827 | 154,679 | 93,033 |
| Titanium: | | | | |
| Ore and concentrate short tons | 4,391 | 1,006 | 8,651 | 1,936 |
| Unwrought and scrap metal do | 5,676 | 9,173 | 4,484 | 9,359 |
| Intermediate mill shapes and mill products, n.e.c do | 2,154 | 52,197 | 2,849 | 61,502 |
| Pigments and oxides do | 93,521 | 92,132 | 108,247 | 102,828 |
| Tungsten (tungsten content): | | | | |
| Ore and concentrate thousand pounds | 2 | 11 | 284 | 1,240 |
| Carbide powder do | 729 | 9,277 | 987 | 12,415 |
| Alloy powder do | 785 | 7,692 | 2,249 | 17,329 |
| Vanadium: | | | | |
| Ore and concentrate (vanadium content) do | 117 | 273 | 24 | 109 |
| Pentoxide, etc do | 5,297 | 7,871 | 7,423 | 14,514 |
| Ferrovanadium do | 1,550 | 6,144 | 938 | 5,205 |
| Zinc: | | | | |
| Slabs, pigs, or blocks metric tons | 427 | 801 | 760 | 975 |
| Sheets, plates, strips, other forms, n.e.c do | 957 | 2,142 | 975 | 2,421 |
| Waste, scrap, dust (zinc content) do | [r]30,169 | [r]18,389 | 42,079 | 23,871 |
| Semifabricated forms, n.e.c do | 1,708 | 3,257 | 1,428 | 2,349 |
| Ore and concentrate do | 60,168 | 22,868 | 30,579 | 13,353 |

See footnotes at end of table.

## Table 8.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| METALS —Continued |  |  |  |  |
| Zirconium: |  |  |  |  |
| Ore and concentrate short tons | 13,222 | $3,316 | 9,528 | $2,647 |
| Oxide do. | 698 | 1,898 | 422 | 1,263 |
| Metals, alloys, other forms do. | 747 | 39,514 | 808 | 42,523 |
| NONMETALS |  |  |  |  |
| Abrasives (includes reexports): |  |  |  |  |
| Industrial diamond, natural or synthetic: |  |  |  |  |
| Powder or dust thousand carats | 42,312 | 82,499 | 47,992 | 74,337 |
| Other do. | 3,185 | 34,065 | 3,301 | 30,441 |
| Diamond grinding wheels do. | 467 | 4,910 | 536 | 5,141 |
| Other natural and artificial metallic abrasives and products | NA | [r] [1]88,627 | NA | [1]99,719 |
| Asbestos: |  |  |  |  |
| Exports: |  |  |  |  |
| Unmanufactured metric tons | 54,236 | 19,398 | 39,779 | 18,221 |
| Products | NA | 128,584 | NA | 162,690 |
| Reexports: |  |  |  |  |
| Unmanufactured metric tons | 398 | 285 | 140 | 125 |
| Products | NA | 998 | NA | 657 |
| Barite: Natural barium sulfate short tons | 22,816 | 3,514 | 1,449 | 574 |
| Boron: |  |  |  |  |
| Boric acid do. | 38,498 | 20,688 | 44,728 | 24,402 |
| Sodium borates, refined do. | 224,672 | 51,000 | 500,537 | 134,000 |
| Bromine compounds thousand pounds | 61,300 | 21,600 | 53,200 | 16,200 |
| Calcium: |  |  |  |  |
| Other calcium compounds including precipitated calcium carbonate short tons | 20,000 | 13,700 | 37,000 | 17,000 |
| Chloride do. | 40,597 | 9,550 | 34,062 | 20,568 |
| Dicalcium phosphate do. | 48,000 | 32,600 | 40,000 | 33,000 |
| Cement: Hydraulic and clinker do. | 118,393 | 17,360 | 80,007 | 13,496 |
| Clays: |  |  |  |  |
| Kaolin or china clay thousand short tons | 1,338 | 157,882 | 1,418 | 170,137 |
| Bentonite do. | 554 | 42,580 | 563 | 45,375 |
| Other do. | 592 | 53,775 | 718 | 80,221 |
| Diatomite do. | 146 | 31,569 | 127 | 29,461 |
| Feldspar, leucite, nepheline syenite short tons | 9,360 | 856 | 10,080 | 920 |
| Fluorspar do. | 9,236 | 962 | 12,266 | 1,292 |
| Gem stones (including reexports): |  |  |  |  |
| Diamond thousand carats | 2,489 | 622,411 | 2,273 | 574,719 |
| Pearls | NA | 4,985 | NA | 8,265 |
| Other | NA | 104,020 | NA | 98,150 |
| Graphite, natural short tons | 9,435 | 3,455 | 7,096 | 2,807 |
| Gypsum: |  |  |  |  |
| Crude, crushed or calcined thousand short tons | 117 | 13,621 | 131 | 12,711 |
| Manufactured, wallboard and plaster articles | NA | 18,467 | NA | 17,141 |
| Helium million cubic feet | 368 | 19,626 | 392 | 21,461 |
| Lime short tons | 28,154 | 4,815 | 24,714 | 6,805 |
| Lithium compounds: |  |  |  |  |
| Lithium carbonate[2] thousand pounds | 17,779 | 23,953 | 18,069 | 24,487 |
| Lithium hydroxide do. | 5,719 | 10,159 | 8,198 | 14,108 |
| Other lithium compounds do. | 4,278 | 8,183 | 5,430 | 9,765 |
| Magnesium compounds: |  |  |  |  |
| Magnesite, dead-burned short tons | 10,855 | 1,955 | 17,275 | 3,641 |
| Magnesite, crude, caustic-calcined, lump or ground do. | 16,621 | 8,426 | 32,053 | 14,026 |
| Mica: |  |  |  |  |
| Waste, scrap, ground thousand pounds | 20,416 | 2,657 | 15,306 | 2,038 |
| Block, film, splittings do. | 70 | 109 | 348 | 549 |
| Manufactured, cut or stamped, built-up | NA | 4,001 | NA | 4,519 |
| Mineral-earth pigments, iron oxide, natural and synthetic short tons | 12,661 | 20,692 | 32,428 | 31,832 |
| Nitrogen compounds (major) thousand short tons | 7,484 | 1,050,061 | 10,439 | 1,635,430 |
| Phosphate rock thousand metric tons | [r]12,010 | [r]327,345 | 11,528 | 324,784 |
| Phosphatic fertilizers: |  |  |  |  |
| Phosphoric acid do. | 1,219 | 322,146 | 1,721 | 396,568 |
| Superphosphates do. | [r]69,804 | [r]166,177 | 2,847 | 1,629 |
| Diammonium phosphates do. | 4,758 | 729,233 | 6,346 | 1,200,579 |
| Elemental phosphorus metric tons | 21,752 | 34,116 | 14,852 | 22,375 |
| Pigments and compounds: Zinc oxide (metal content) do. | 330 | 492 | 288 | 627 |
| Potash: |  |  |  |  |
| Potassium chloride do. | 385,980 | 30,700 | 621,820 | 57,200 |
| Potassium sulfate do. | 86,320 | 16,390 | 67,320 | 13,940 |
| Quartz, crystal: |  |  |  |  |
| Cultured thousand pounds | 80 | 3,258 | 277 | 11,021 |
| Natural do. | 28 | 156 | 42 | 234 |

See footnotes at end of table.

## Table 8.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| NONMETALS —Continued | | | | |
| Salt: | | | | |
| Crude and refined thousand short tons | 517 | $12,368 | 820 | $15,299 |
| Shipments to noncontiguous territories do. | 30 | 4,101 | 19 | 2,301 |
| Sand and gravel: | | | | |
| Construction: | | | | |
| Sand do. | 934 | 4,620 | 1,210 | 8,094 |
| Gravel do. | 369 | 1,810 | 635 | 2,231 |
| Industrial sand do. | 1,047 | 26,057 | 1,193 | 27,656 |
| Sodium compounds: | | | | |
| Sodium sulfate do. | 91 | 11,380 | 76 | 9,587 |
| Sodium carbonate do. | 1,636 | 154,584 | 1,648 | 160,774 |
| Stone: | | | | |
| Crushed do. | 2,413 | 23,021 | 2,378 | 23,970 |
| Dimension | NA | 21,185 | NA | 26,318 |
| Sulfur, crude thousand metric tons | 992 | 109,298 | 1,334 | 156,067 |
| Talc, crude and ground thousand short tons | 218 | 12,916 | 256 | 16,162 |
| Total | XX | $^{r}$12,235,430 | XX | 13,992,604 |

$^{r}$Revised. NA Not available. XX Not applicable.

[1] Silicon carbide (crude and refined) has been deducted and is shown separately elsewhere in this table.

[2] Before 1982, lithium carbonate exports were included with "Other lithium compounds."

## Table 9.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| METALS | | | | |
| Aluminum: | | | | |
| Metal metric tons | 742,691 | $1,021,273 | 881,956 | $1,292,724 |
| Scrap do. | 88,472 | 87,468 | 137,675 | 145,748 |
| Plates, sheets, bars, etc do. | 260,012 | 537,319 | 457,562 | 1,027,631 |
| Aluminum oxide (alumina) thousand metric tons | 4,030 | 811,021 | 4,466 | 976,364 |
| Antimony: | | | | |
| Ore and concentrate (antimony content) short tons | 2,770 | 2,335 | 4,299 | 6,798 |
| Sulfide including needle or liquated do. | 47 | 58 | 72 | 157 |
| Metal do. | 1,282 | 1,987 | 3,898 | 8,037 |
| Oxide do. | 10,604 | 13,318 | 17,884 | 26,348 |
| Arsenic: | | | | |
| White ($As_2O_3$ content) do. | 10,186 | 8,406 | 13,985 | 9,454 |
| Metallic do. | 243 | 1,401 | 304 | 2,127 |
| Bauxite, crude thousand metric tons | 7,601 | NA | 9,428 | NA |
| Beryllium ore short tons | 2,194 | 2,755 | 1,332 | 1,177 |
| Bismuth, metals and alloys (gross weight) pounds | 1,971,956 | 3,121 | 1,948,394 | 5,892 |
| Cadmium metal metric tons | 2,196 | 3,842 | 1,889 | 5,133 |
| Calcium metal pounds | 332,834 | 866 | 248,973 | 670 |
| Cesium compounds and chloride do. | 19,227 | 617 | 53,652 | 1,552 |
| Chromium: | | | | |
| Ore and concentrate ($Cr_2O_3$ content) thousand short tons | 86 | 10,390 | 134 | 15,477 |
| Ferrochromium (gross weight) do. | 280 | 109,012 | 426 | 183,451 |
| Ferrochromium-silicon do. | 1 | 670 | 8 | 3,736 |
| Metal do. | 3 | 13,687 | 5 | 24,073 |
| Cobalt: | | | | |
| Metal thousand pounds | 15,853 | 110,076 | 23,316 | 202,954 |
| Oxide (gross weight) do. | 403 | 1,813 | 706 | 5,285 |
| Salts and compounds (gross weight) do. | 1,671 | 2,244 | 2,284 | 5,371 |
| Columbium ore do. | 1,482 | 3,316 | 3,265 | 6,030 |
| Copper (copper content): | | | | |
| Ore and concentrate metric tons | 90,597 | 81,695 | 11,056 | 9,863 |
| Matte do. | $^{r}$3,286 | $^{r}$4,318 | 2,094 | 2,586 |
| Blister do. | 46,371 | 66,027 | 38,949 | 52,950 |
| Refined in ingots, etc do. | 459,568 | 700,564 | 444,699 | 620,674 |
| Scrap do. | $^{r}$23,086 | $^{r}$32,183 | 23,005 | 28,925 |
| Ferroalloys not elsewhere listed, including spiegeleisen short tons | 3,098 | 15,801 | 5,321 | 27,304 |
| Gallium kilograms | 7,294 | 3,195 | 9,669 | 4,050 |
| Germanium do. | 20,916 | 10,527 | 116,719 | 7,539 |

See footnotes at end of table.

## Table 9.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| METALS —Continued | | | | |
| Gold: | | | | |
| Ore and base bullion troy ounces | $^{r}$993,768 | $401,548 | 1,837,052 | $653,307 |
| Bullion, refined do. | 3,559,188 | 1,575,570 | 6,031,550 | 2,293,606 |
| Hafnium short tons | (1) | 50 | 1 | 115 |
| Indium thousand troy ounces | 1,073 | 2,795 | 1,022 | 4,577 |
| Iron ore thousand long tons | 13,246 | 445,731 | 17,187 | 529,065 |
| Iron and steel: | | | | |
| Pig iron short tons | 242,114 | 31,917 | 702,355 | 83,985 |
| Iron and steel products (major): | | | | |
| Steel mill products do. | 17,034,388 | 6,333,636 | 26,169,313 | 10,201,206 |
| Other products do. | 804,095 | 795,481 | 1,145,868 | 1,155,254 |
| Scrap including tinplate thousand short tons | 641 | 48,219 | 572 | 46,946 |
| Lead: | | | | |
| Ore, flue dust, matte (lead content) metric tons | 19,753 | 5,712 | 29,888 | 11,923 |
| Base bullion (lead content) do. | 53 | 23 | 43 | 57 |
| Pigs and bars (lead content) do. | 134,357 | 64,225 | 161,489 | 86,189 |
| Reclaimed scrap, etc. (lead content) do. | 4,212 | 1,340 | 5,026 | 2,029 |
| Sheets, pipes, shot do. | 496 | 1,632 | 1,667 | 4,044 |
| Magnesium: | | | | |
| Metal and scrap short tons | 3,969 | 7,174 | 5,296 | 12,260 |
| Alloys (magnesium content) do. | 2,143 | 6,151 | 3,596 | 10,791 |
| Sheets, tubing, ribbons, wire, other forms (magnesium content) do. | 238 | 2,939 | 489 | 2,620 |
| Manganese: | | | | |
| Ore (35% or more contained manganese) do. | 368,297 | 19,867 | 338,094 | 16,024 |
| Ferromanganese do. | 341,608 | 93,083 | 409,310 | 117,678 |
| Ferrosilicon-manganese (manganese content) do. | 91,992 | 40,117 | 91,339 | 44,746 |
| Metal do. | 5,950 | 5,323 | 13,314 | 12,978 |
| Mercury: | | | | |
| Compounds pounds | 135,758 | 717 | 89,519 | 465 |
| Metal 76-pound flasks | 12,786 | 3,813 | 25,327 | 7,274 |
| Molybdenum: | | | | |
| Ore and concentrate (molybdenum content) thousand pounds | 1,673 | 3,528 | 28 | 183 |
| Waste and scrap (gross weight) do. | NA | 2,141 | NA | 2,565 |
| Metal: | | | | |
| Unwrought (molybdenum content) do. | 97 | 1,398 | 142 | 2,170 |
| Wrought (gross weight) do. | 94 | 2,331 | 132 | 3,023 |
| Ferromolybdenum (gross weight) do. | 1,157 | 3,189 | 2,086 | 4,438 |
| Material in chief value molybdenum (molybdenum content) do. | 3,445 | 12,985 | 5,266 | 19,441 |
| Compounds (gross weight) do. | 5,791 | 9,425 | 3,437 | 6,251 |
| Nickel: | | | | |
| Pigs, ingots, shot, cathodes short tons | 90,839 | 418,943 | 103,017 | 461,371 |
| Plates, bars, etc do. | 4,105 | 84,553 | 8,650 | 58,120 |
| Slurry do. | 62,454 | 83,613 | 82,509 | 116,956 |
| Scrap do. | 6,071 | 17,691 | 6,199 | 20,542 |
| Powder and flakes do. | 12,725 | 65,747 | 15,829 | 78,736 |
| Ferronickel do. | 45,134 | 65,264 | 43,048 | 68,429 |
| Oxide do. | 4,209 | 19,083 | 5,526 | 22,413 |
| Platinum-group metals: | | | | |
| Unwrought: | | | | |
| Grains and nuggets (platinum) troy ounces | 8,513 | 2,145 | 19,786 | 5,647 |
| Sponge (platinum) do. | 1,005,208 | $^{r}$435,330 | 1,527,841 | 617,888 |
| Sweepings, waste, scrap do. | 417,431 | 44,308 | 526,738 | 61,920 |
| Iridium do. | 23,266 | $^{r}$7,151 | 18,225 | 7,472 |
| Palladium do. | 1,223,951 | 151,149 | 1,795,939 | 273,222 |
| Rhodium do. | 119,958 | 48,171 | 155,671 | 83,979 |
| Ruthenium do. | 163,623 | 5,379 | 198,257 | 16,652 |
| Other platinum-group metals do. | 22,875 | 7,248 | 10,602 | 3,796 |
| Semimanufactured: | | | | |
| Platinum do. | 109,376 | 36,663 | 60,140 | 22,682 |
| Palladium do. | 108,247 | 12,643 | 158,012 | 24,192 |
| Rhodium do. | 11,245 | 1,539 | 2,389 | 516 |
| Other platinum-group metals do. | $^{r}$4,329 | $^{r}$1,030 | 506 | 122 |
| Rare-earth metals: | | | | |
| Ferrocerium and other cerium alloys kilograms | 104,696 | 1,185 | 138,128 | 1,651 |
| Monazite metric tons | 4,028 | 1,517 | 5,661 | 2,202 |
| Metals including scandium and yttrium kilograms | 801 | 182 | 4,316 | 619 |
| Rhenium: | | | | |
| Metal including scrap pounds | 623 | 180 | 1,962 | 450 |
| Ammonium perrhenate do. | 5,947 | 1,131 | 6,790 | 1,052 |
| Selenium and selenium compounds (selenium content) kilograms | 297,029 | 5,922 | 376,946 | 8,054 |
| Silicon: | | | | |
| Metal (over 96% silicon content) short tons | 28,173 | 52,026 | 25,221 | 55,381 |
| Ferrosilicon do. | 159,443 | 67,445 | 143,651 | 72,874 |

See footnotes at end of table.

## Table 9.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| METALS —Continued |  |  |  |  |
| Silver: |  |  |  |  |
| Ore and base bullion thousand troy ounces | 13,911 | $145,419 | 13,018 | $105,587 |
| Bullion, refined do | 161,199 | 1,926,102 | 93,546 | 784,838 |
| Sweepings, waste, doré do | 4,781 | 52,048 | 8,402 | 72,772 |
| Tantalum ore thousand pounds | 536 | 4,017 | 2,199 | 19,054 |
| Tellurium (tellurium content) kilograms | 11,829 | 622 | 35,382 | 725 |
| Thallium pounds | 3,110 | 448 | 2,964 | 96 |
| Tin: |  |  |  |  |
| Concentrate (tin content) metric tons | 969 | 9,549 | 3,272 | 20,862 |
| Dross, skimmings, scrap, residue, tin alloys, n.s.p.f. do | 1,193 | 1,219 | 1,211 | 1,318 |
| Tinfoil, powder, flitters, etc | NA | 10,728 | NA | 3,292 |
| Tin scrap and other tin-bearing material excluding tinplate scrap | NA | NA | NA | NA |
| Tin compounds metric tons | 642 | 4,120 | 838 | 5,301 |
| Titanium: |  |  |  |  |
| Ilmenite[2] short tons | 398,036 | 29,423 | 619,444 | 43,846 |
| Rutile do | 111,578 | 23,532 | 180,508 | 44,910 |
| Metal do | 3,787 | 27,899 | 5,533 | 35,469 |
| Ferrotitanium and ferrosilicon titanium do | 893 | 1,288 | 579 | 861 |
| Pigments do | 174,857 | 165,495 | 193,501 | 186,952 |
| Tungsten ore and concentrate (tungsten content) thousand pounds | 6,307 | 25,717 | 12,802 | 51,715 |
| Vanadium (vanadium content): |  |  |  |  |
| Ferrovanadium do | [r]1,361 | [r]6,254 | 2,341 | 11,839 |
| Pentoxide do | 754 | 2,363 | 297 | 1,269 |
| Vanadium-bearing materials do | 115 | 86 | 1,266 | 552 |
| Zinc: |  |  |  |  |
| Ore (zinc content) metric tons | 63,156 | 16,548 | 86,172 | 29,186 |
| Blocks, pigs, slabs do | 617,679 | 503,888 | 639,228 | 635,940 |
| Sheets, etc do | 319 | 426 | 850 | 1,308 |
| Fume (zinc content) do | 631 | 420 | 314 | 171 |
| Waste and scrap do | 3,900 | 1,676 | 6,259 | 3,940 |
| Dross and skimmings do | 6,508 | 3,314 | 5,027 | 3,161 |
| Dust, powder, flakes do | 6,533 | 7,126 | 7,572 | 9,505 |
| Manufactured | NA | 543 | NA | 927 |
| Zirconium: |  |  |  |  |
| Ore including zirconium sand short tons | 44,487 | 4,420 | 66,436 | 7,548 |
| Metal, scrap, compounds do | 1,687 | 15,901 | 1,844 | 20,330 |
| NONMETALS |  |  |  |  |
| Abrasives: |  |  |  |  |
| Diamond (industrial) thousand carats | 24,877 | 88,617 | 43,710 | 113,632 |
| Other | NA | 201,248 | NA | 268,062 |
| Asbestos metric tons | 196,387 | 57,956 | 209,963 | 64,749 |
| Barite: |  |  |  |  |
| Crude and ground thousand short tons | 1,397 | 67,404 | 1,776 | 74,945 |
| Witherite short tons | 50 | 16 | 226 | 153 |
| Chemicals do | 27,832 | 16,093 | 35,208 | 20,524 |
| Boron: |  |  |  |  |
| Boric acid do | 7,881 | 3,456 | 7,748 | 3,449 |
| Calcium borate, crude[3] do | 40,000 | 8,309 | 51,334 | 12,123 |
| Calcium chloride do | 13,784 | [r]1,317 | 22,078 | 1,817 |
| Cement: Hydraulic and clinker thousand short tons | 4,268 | 161,439 | 8,846 | 249,207 |
| Clays short tons | 20,864 | 3,488 | 31,585 | 4,868 |
| Cryolite do | 7,199 | 4,784 | 22,722 | 13,124 |
| Feldspar: |  |  |  |  |
| Crude do | 18 | 6 | 2 | 1 |
| Ground and crushed do | 46 | 25 | 23 | 14 |
| Fluorspar do | 453,314 | 47,032 | 703,711 | 65,241 |
| Gem stones: |  |  |  |  |
| Diamond thousand carats | 6,265 | 2,275,373 | 8,227 | 2,905,317 |
| Emeralds do | 2,117 | 134,130 | 4,410 | 154,644 |
| Other | NA | 446,951 | NA | 591,555 |
| Graphite, natural short tons | 43,586 | 11,921 | 58,246 | 14,579 |
| Gypsum: |  |  |  |  |
| Crude, ground, calcined thousand short tons | 8,035 | [r]57,265 | 8,915 | 74,357 |
| Manufactured | NA | 30,614 | NA | 95,310 |
| Iodine, crude thousand pounds | 6,218 | 34,039 | 5,067 | 24,312 |
| Lime: |  |  |  |  |
| Hydrated short tons | 58,811 | 3,431 | 59,906 | 3,669 |
| Other do | 223,752 | 11,345 | 187,579 | 9,722 |
| Lithium: |  |  |  |  |
| Ore do | 8 | 4 | 60 | 24 |
| Compounds do | 189 | 1,978 | 462 | 2,313 |

See footnotes at end of table.

## Table 9.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| NONMETALS —Continued | | | | |
| Magnesium compounds: | | | | |
| Crude magnesite short tons | $^{r}$66 | $25 | 745 | $232 |
| Lump or ground caustic-calcined magnesia do | $^{r}$31,429 | 5,476 | 54,026 | 9,594 |
| Refractory magnesia, dead-burned, fused magnesite, dead-burned dolomite do | 80,429 | 14,340 | 155,162 | 26,187 |
| Compounds do | 50,029 | 9,780 | 46,153 | 10,036 |
| Mica: | | | | |
| Waste, scrap, ground thousand pounds | 14,091 | 2,189 | 23,198 | 3,251 |
| Block, film, splittings do | 1,899 | 986 | 1,480 | 644 |
| Manufactured, cut or stamped, built-up do | 735 | 2,583 | 856 | 2,836 |
| Mineral-earth pigments, iron oxide: | | | | |
| Ocher, crude and refined short tons | (1) | 3 | 7 | 31 |
| Siennas, crude and refined do | 141 | 56 | 160 | 72 |
| Umber, crude and refined do | 6,640 | 996 | 6,401 | 1,012 |
| Vandyke brown do | 769 | 309 | 659 | 244 |
| Other natural and refined do | 841 | 342 | 996 | 444 |
| Synthetic do | 22,356 | 14,978 | 30,015 | 19,720 |
| Nepheline syenite: | | | | |
| Crude do | 212 | 13 | 410 | 17 |
| Ground, crushed, etc do | 407,139 | 13,984 | 377,535 | 14,201 |
| Nitrogen compounds (major) including urea thousand short tons | 6,281 | 793,574 | 8,476 | 984,524 |
| Peat: | | | | |
| Fertilizer-grade short tons | 371,486 | 46,001 | 453,387 | 53,491 |
| Poultry- and stable-grade do | 47,220 | 6,066 | 31,685 | 4,318 |
| Phosphates, crude and apatite thousand metric tons | 9 | $^{r}$305 | 9 | 274 |
| Phosphatic fertilizers: | | | | |
| Fertilizer and fertilizer materials do | 36 | 3,622 | 119 | 7,536 |
| Elemental phosphorus do | $^{r}$2,122 | $^{r}$3,362 | 4,222 | 6,482 |
| Other do | $^{r}$11 | $^{r}$1,618 | 11 | 1,550 |
| Pigments and salts: | | | | |
| Lead pigments and compounds metric tons | 15,667 | 11,444 | 19,081 | 15,022 |
| Zinc pigments and compounds do | 40,876 | 34,709 | 52,432 | 48,178 |
| Potash do | 7,322,100 | 600,600 | 7,947,700 | 658,100 |
| Pumice: | | | | |
| Crude or unmanufactured short tons | 2,699 | 113 | 16,703 | 402 |
| Wholly or partly manufactured do | 181,606 | 1,166 | 276,023 | 1,933 |
| Manufactured, n.s.p.f | NA | 106 | NA | 148 |
| Quartz crystal (Brazilian lascas) thousand pounds | 153 | 121 | 569 | 373 |
| Salt thousand short tons | 5,997 | 60,194 | 7,545 | 74,100 |
| Sand and gravel: | | | | |
| Industrial sand do | 58 | 1,619 | 26 | 926 |
| Other sand and gravel do | 123 | 1,047 | 151 | 1,603 |
| Sodium compounds: | | | | |
| Sodium carbonate do | 20 | 2,704 | 17 | 2,301 |
| Sodium sulfate do | 343 | 27,921 | 265 | 21,198 |
| Stone: | | | | |
| Crushed do | $^{r}$2,279 | 10,709 | 2,923 | 15,071 |
| Dimension | NA | 195,378 | NA | 231,678 |
| Calcium carbonate fines thousand short tons | $^{r}$384 | $^{r}$1,901 | 292 | 2,471 |
| Strontium: | | | | |
| Minerals short tons | 49,796 | $^{r}$3,707 | 48,852 | 4,293 |
| Compounds do | $^{r}$1,137 | $^{r}$1,099 | 4,755 | 3,386 |
| Sulfur and compounds, sulfur ore and other forms, n.e.s thousand metric tons | 1,695 | 129,110 | 2,557 | 200,189 |
| Talc, unmanufactured thousand short tons | 44 | 7,691 | 45 | 9,156 |
| Total | XX | $^{r}$23,891,382 | XX | 31,440,437 |

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$^{r}$Revised. NA Not available. XX Not applicable.

[1] Less than 1/2 unit.

[2] Includes titanium slag averaging about 70% $TiO_2$. For details, see "Titanium" chapter.

[3] Owing to a change of reporting, 1982 calcium borate, crude, imports are not comparable with those of previous years.

## Table 10.—Comparison of world and U.S. production of selected nonfuel mineral commodities

(Thousand short tons unless otherwise specified)

| Mineral | 1983 | | | 1984p | | |
|---|---|---|---|---|---|---|
| | World production[1] | U.S. production | U.S. percent of world production | World production[1] | U.S. production | U.S. percent of world production |
| METALS, MINE BASIS | | | | | | |
| Antimony (content of ore and concentrate) short tons | 55,526 | 838 | 2 | 58,857 | 557 | 1 |
| Arsenic trioxide[2] metric tons | 26,210 | W | NA | 32,674 | W | NA |
| Bauxite[3] thousand metric tons | 78,861 | 679 | 1 | 84,664 | 856 | 1 |
| Beryl short tons | 10,335 | 6,665 | 64 | 9,670 | 6,030 | 62 |
| Bismuth thousand pounds | 8,431 | W | NA | 8,675 | W | NA |
| Chromite | 9,387 | -- | -- | 10,468 | -- | -- |
| Cobalt (content of ore and concentrate) short tons | 26,445 | -- | -- | 34,245 | -- | -- |
| Columbium-tantalum concentrate (gross weight) thousand pounds | 46,908 | -- | -- | 67,236 | -- | -- |
| Copper (content of ore and concentrate) thousand metric tons | 7,690 | 1,038 | 13 | 7,909 | 1,091 | 14 |
| Gold (content of ore and concentrate) thousand troy ounces | 44,882 | 1,956 | 4 | 46,035 | 2,059 | 4 |
| Iron ore (gross weight) thousand long tons | 723,893 | 37,562 | 5 | 789,440 | 51,269 | 6 |
| Lead (content of ore and concentrate) thousand metric tons | 3,366 | 466 | 14 | 3,190 | 333 | 10 |
| Manganese ore (35% or more Mn, gross weight) | 24,093 | -- | -- | 25,341 | -- | -- |
| Mercury thousand 76-pound flasks | 181 | 25 | 14 | 174 | 19 | 11 |
| Molybdenum (content of ore and concentrate) thousand pounds | 140,295 | 33,593 | 24 | 208,665 | 103,664 | 50 |
| Nickel (content of ore and concentrate) | 723 | -- | -- | 820 | 15 | 2 |
| Platinum-group metals[2] thousand troy ounces | 6,524 | 6 | (4) | 7,053 | 15 | (4) |
| Silver (content of ore and concentrate) do | 392,268 | 43,415 | 11 | 398,554 | 44,440 | 11 |
| Tin (content of ore and concentrate) metric tons | 210,653 | W | NA | 207,842 | W | NA |
| Titanium concentrates (gross weight): | | | | | | |
| Ilmenite | 2,967 | W | NA | 3,183 | W | NA |
| Rutile | 351 | W | NA | 391 | W | NA |
| Tungsten ore and concentrate (contained tungsten) metric tons | 39,430 | 980 | 2 | 44,939 | 1,203 | 3 |
| Vanadium (content of ore and concentrate) short tons | 30,924 | 2,171 | 7 | 34,292 | 1,617 | 5 |
| Zinc (content of ore and concentrate) thousand metric tons | 6,160 | 297 | 5 | 6,419 | 278 | 4 |
| METALS, SMELTER BASIS | | | | | | |
| Aluminum (primary only) do | 13,945 | 3,353 | 24 | 15,521 | 4,099 | 26 |
| Cadmium metric tons | 16,725 | 1,052 | 6 | 17,687 | 1,686 | 10 |
| Cobalt short tons | 19,425 | 103 | 1 | 24,227 | -- | -- |
| Copper smelter (primary and secondary)[5] thousand metric tons | 8,092 | 987 | 12 | 8,258 | 1,060 | 13 |
| Iron, pig | 510,506 | 48,770 | 10 | 539,216 | 51,961 | 10 |
| Lead, smelter (primary and secondary)[6] thousand metric tons | 5,267 | 1,018 | 19 | 5,319 | 979 | 18 |
| Magnesium (primary) | 286 | 115 | 40 | 358 | 159 | 44 |
| Nickel[7] | 704 | 33 | 5 | 756 | 45 | 6 |
| Selenium[8] kilograms | 1,407,311 | 353,860 | 25 | 1,180,729 | W | NA |
| Steel, raw | 730,291 | [9]84,615 | 12 | 778,928 | [9]92,528 | 12 |
| Tellurium[8] kilograms | 93,616 | W | NA | 92,175 | W | NA |
| Tin metric tons | 211,756 | [10]2,500 | 1 | 209,049 | [10]4,000 | 2 |
| Zinc (primary and secondary) thousand metric tons | 6,201 | 305 | 5 | 6,448 | 331 | 5 |
| NONMETALS | | | | | | |
| Asbestos do | 4,276 | 70 | 2 | 4,338 | 57 | 1 |
| Barite | 5,986 | [11]754 | 13 | 6,313 | [11]775 | 12 |
| Boron minerals | 2,446 | 1,303 | 53 | 2,541 | 1,367 | 54 |
| Bromine thousand pounds | 788,863 | [11]370,000 | 47 | 855,730 | [11]385,000 | 45 |
| Cement, hydraulic | 1,008,418 | [12]71,347 | 7 | 1,058,721 | [12]78,699 | 7 |
| Clays: | | | | | | |
| Bentonite[8] | 5,708 | [11]2,887 | 51 | 5,988 | [11]3,154 | 53 |
| Fuller's earth[8] | 2,488 | [11]1,912 | 77 | 2,526 | [11]1,899 | 75 |
| Kaolin[2] | 21,656 | [11]7,203 | 33 | 24,298 | [11]7,953 | 33 |

See footnotes at end of table.

## Table 10.—Comparison of world and U.S. production of selected nonfuel mineral commodities —Continued

(Thousand short tons unless otherwise specified)

| Mineral | 1983 | | | 1984[p] | | |
|---|---|---|---|---|---|---|
| | World production[1] | U.S. production | U.S. percent of world production | World production[1] | U.S. production | U.S. percent of world production |
| NONMETALS —Continued | | | | | | |
| Corundum ____________ short tons__ | 20,096 | -- | -- | 19,627 | -- | -- |
| Diamond ________ thousand carats__ | 55,819 | -- | -- | 63,830 | -- | -- |
| Diatomite ____________________ | 1,668 | 619 | 37 | 1,664 | 627 | 38 |
| Feldspar ____________________ | 4,082 | 710 | 17 | 4,011 | 710 | 18 |
| Fluorspar ____________________ | 4,738 | 61 | 1 | 5,070 | 72 | 1 |
| Graphite ____________ short tons__ | 636,995 | W | NA | 631,842 | W | NA |
| Gypsum ____________________ | 86,374 | 12,884 | 15 | 90,302 | 14,319 | 16 |
| Iodine, crude _____ thousand pounds__ | 27,649 | W | NA | 27,255 | W | NA |
| Lime ____________________ | 121,947 | [11, 12]14,902 | 12 | 124,796 | [11, 12]15,956 | 13 |
| Magnesite ____________________ | 12,320 | W | NA | 11,953 | W | NA |
| Mica (including scrap and ground) thousand pounds__ | 528,934 | 280,000 | 53 | 575,375 | 322,000 | 56 |
| Nitrogen, N content of ammonia ______ | 85,414 | 11,297 | 13 | 90,176 | 13,309 | 15 |
| Peat ____________________ | 411,868 | 704 | (4) | 413,069 | 800 | (4) |
| Perlite ____________________ | 1,441 | [11]474 | 33 | 1,449 | [11]498 | 34 |
| Phosphate rock (gross weight) thousand metric tons__ | 139,265 | 42,573 | 31 | 150,571 | 49,197 | 33 |
| Potash ($K_2O$ equivalent) ______ do____ | 27,426 | 1,429 | 5 | 28,638 | 1,564 | 5 |
| Pumice[8] ____________________ | 12,404 | [11]449 | 4 | 13,365 | [11]502 | 4 |
| Salt ____________________ | 175,563 | [11, 12]34,605 | 20 | 185,132 | [11, 12]39,255 | 21 |
| Sodium compounds, natural and manufactured: | | | | | | |
| Sodium carbonate ______________ | 31,291 | 8,467 | 27 | 31,499 | 8,511 | 27 |
| Sodium sulfate ______________ | 4,410 | 855 | 19 | 4,364 | 872 | 20 |
| Strontium[8] ____________ short tons__ | 150,942 | -- | -- | 148,730 | -- | -- |
| Sulfur, all forms thousand metric tons__ | 50,315 | 9,290 | 18 | 51,884 | 10,652 | 21 |
| Talc and pyrophyllite ______________ | 7,800 | 1,066 | 14 | 7,967 | 1,170 | 15 |
| Vermiculite[8] ________________ | 493 | 282 | 57 | 550 | 315 | 57 |

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[p] Preliminary. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] For those commodities for which U.S. data are withheld to avoid disclosing company proprietary data, the world total excludes U.S. output and the U.S. percent of world production cannot be reported.

[2] World total does not include an estimate for output in China.

[3] U.S. figures represent dried bauxite equivalent of crude ore; to the extent possible, individual country figures that are included in the world total are also on the dried bauxite equivalent basis, but for some countries, available data are insufficient to permit this adjustment.

[4] Less than 0.5%.

[5] Primary and secondary blister and anode copper, including electrowon refined copper that is not included as blister or anode.

[6] Includes bullion.

[7] Refined nickel plus nickel content of ferronickel, and nickel oxide.

[8] World total does not include estimates for output in the U.S.S.R. or China.

[9] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not report steel ingot.

[10] Includes tin content of alloys made directly from ore.

[11] Quantity sold or used by producers.

[12] Includes Puerto Rico.

# The Mineral Industry of Alabama

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Alabama for collecting information on all nonfuel minerals.**

## By James R. Boyle[1] and Ernest A. Mancini[2]

The value of Alabama's nonfuel mineral production in 1984 was $409.8 million, and established a new record high for value of nonfuel minerals in the State, at 13.4% over the previous high of 1983. Output of nearly all nonfuel minerals increased; phosphate rock was one of the exceptions, with no recorded output in 1984. Cement, crushed stone, lime, sand and gravel, and clays were the major commodities produced in Alabama.

Alabama led the Nation in the production of crushed marble; was second in bauxite; third in fire clay and kaolin; fourth in bentonite, ferroalloys, and dimension marble; fifth in masonry cement, lime, and recovered sulfur; and sixth in portland cement. Alabama ranked 22d in the Nation in value of nonfuel minerals produced.

**Table 1.—Nonfuel mineral production in Alabama[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Cement: | | | | |
| Masonry thousand short tons | 210 | $13,417 | 259 | $17,247 |
| Portland do | 3,279 | 150,255 | 3,656 | 167,191 |
| Clays[2] do | 1,863 | 20,758 | 1,906 | 30,500 |
| Gem stones | NA | 1 | NA | 1 |
| Lime thousand short tons | 981 | 41,149 | 1,163 | 50,560 |
| Sand and gravel: | | | | |
| Construction do | [e]8,600 | [e]23,500 | 10,348 | 26,188 |
| Industrial do | 418 | 3,256 | 442 | 3,600 |
| Stone: | | | | |
| Crushed do | 20,558 | 95,374 | [e]22,000 | [e]98,500 |
| Dimension do | 7 | 2,661 | [e]8 | [e]2,674 |
| Combined value of bauxite, clays (bentonite), phosphate rock (1983), and salt | XX | [r]10,956 | XX | 13,380 |
| Total | XX | [r]361,327 | XX | 409,841 |

[e]Estimated. [r]Revised. NA Not available. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes bentonite; value included with "Combined value" figure.

### Table 2.—Value of nonfuel mineral production in Alabama, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Autauga | W | (2) | |
| Baldwin | W | W | Clays. |
| Barbour | W | W | Clays, bauxite. |
| Bibb | W | W | Clays. |
| Blount | W | W | Stone (dimension). |
| Calhoun | W | $5,310 | Stone (crushed), clays. |
| Chilton | W | 106 | Clays. |
| Clarke | W | (2) | |
| Coffee | W | (2) | |
| Colbert | $45 | 7,214 | Stone (crushed). |
| Coosa | (3) | W | Do. |
| Crenshaw | 37 | 51 | Sand and gravel (industrial). |
| Dale | W | (2) | |
| Dallas | 1,618 | W | Sand and gravel (industrial), clays. |
| De Kalb | (3) | 654 | Stone (crushed). |
| Elmore | 2,156 | 398 | Clays. |
| Escambia | 637 | (2) | |
| Etowah | 270 | W | Stone (crushed). |
| Fayette | 190 | (2) | |
| Franklin | 1,092 | W | Stone (dimension), stone (crushed). |
| Geneva | W | (2) | |
| Hale | W | (2) | |
| Henry | W | W | Clays, bauxite. |
| Jackson | (3) | W | Stone (crushed). |
| Jefferson | W | W | Cement, stone (crushed), clays. |
| Lawrence | (3) | 701 | Stone (crushed). |
| Lee | (3) | W | Do. |
| Limestone | W | W | Phosphate rock. |
| Lowndes | W | W | Clays. |
| Macon | W | W | Sand and gravel (industrial). |
| Madison | W | W | Stone (crushed), clays. |
| Marengo | W | W | Cement. |
| Marion | 275 | (2) | |
| Marshall | W | W | Stone (crushed), clays. |
| Mobile | 29,900 | W | Cement, clays, sand and gravel (industrial). |
| Monroe | (3) | W | Stone (crushed). |
| Montgomery | W | (2) | |
| Morgan | (3) | W | Stone (crushed). |
| Randolph | (3) | 170 | Do. |
| Russell | W | W | Clays. |
| St. Clair | W | W | Cement, stone (crushed), clays. |
| Shelby | W | 93,044 | Lime, cement, stone (crushed), clays. |
| Sumter | W | W | Clays, stone (crushed). |
| Talladega | (3) | W | Stone (crushed), stone (dimension). |
| Tuscaloosa | W | W | Sand and gravel (industrial). |
| Walker | W | W | Clays. |
| Washington | W | W | Salt. |
| Wilcox | (2) | (2) | |
| Undistributed[4] | 171,247 | 230,179 | |
| Sand and gravel (construction) | XX | [e]23,500 | |
| Stone: | | | |
| Crushed | [e]89,600 | XX | |
| Dimension | [r] [e]2,094 | XX | |
| Total | [r] [5]299,162 | 361,327 | |

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[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[4] Includes gem stones and sand and gravel (construction, 1982) that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Alabama business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 3,941 | 3,961 | 3,990 |
| Total civilian labor force | do. | 1,713 | 1,758 | 1,794 |
| Unemployment | do. | 247 | 240 | 200 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do. | 16.1 | 13.7 | 14.4 |
| Nonmetallic minerals except fuels[2] | do. | 2.2 | 2.1 | NA |
| Coal mining | do. | 11.7 | 9.7 | 10.0 |
| Oil and gas extraction[2] | do. | 1.9 | 1.7 | NA |
| Manufacturing total | do. | 337.8 | 340.9 | 358.4 |
| Primary metal industries | do. | 29.6 | 24.8 | 26.4 |
| Stone, clay, and glass products | do. | 8.6 | 8.7 | 8.8 |
| Chemicals and allied products | do. | 13.1 | 11.8 | 11.9 |
| Petroleum and coal products[2] | do. | 1.4 | 1.4 | NA |
| Construction | do. | 56.8 | 59.8 | 64.5 |
| Transportation and public utilities | do. | 71.1 | 69.7 | 72.1 |
| Wholesale and retail trade | do. | 267.4 | 273.2 | 290.3 |
| Finance, insurance, real estate | do. | 58.8 | 59.9 | 62.6 |
| Services | do. | 214.4 | 218.9 | 227.4 |
| Government and government enterprises | do. | 290.1 | 292.7 | 298.8 |
| Total | do. | 1,312.5 | 1,328.8 | 1,383.5 |
| Personal income: | | | | |
| Total | millions | $34,191 | $36,436 | $39,869 |
| Per capita | | $8,675 | $9,200 | $9,992 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.5 | 40.7 | 41.0 |
| Mining | | 38.8 | 41.4 | 42.6 |
| Total average hourly average earnings, production workers | | $7.33 | $7.58 | $7.97 |
| Mining | | $11.85 | $12.50 | $13.18 |
| Earnings by industry: | | | | |
| Farm income | millions | $579 | $496 | $706 |
| Nonfarm | do. | $23,305 | $25,095 | $27,529 |
| Mining total | do. | $508 | $435 | $492 |
| Nonmetallic minerals except fuels | do. | $46 | $46 | $54 |
| Coal mining | do. | $407 | W | W |
| Oil and gas extraction | do. | $60 | $48 | $55 |
| Manufacturing total | do. | $6,408 | $6,884 | $7,707 |
| Primary metal industries | do. | $842 | $730 | $820 |
| Stone, clay, and glass products | do. | $178 | $192 | $205 |
| Chemicals and allied products | do. | $362 | $348 | $379 |
| Petroleum and coal products | do. | $46 | $50 | $55 |
| Construction | do. | $1,188 | $1,265 | $1,371 |
| Transportation and public utilities | do. | $1,892 | $2,036 | $2,171 |
| Wholesale and retail trade | do. | $3,501 | $3,762 | $4,197 |
| Finance, insurance, real estate | do. | $1,035 | $1,180 | $1,315 |
| Services | do. | $3,563 | $3,951 | $4,353 |
| Government and government enterprises | do. | $5,116 | $5,477 | $5,806 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 9,011 | 17,732 | 14,736 |
| Value of nonresidential construction | millions | $393.2 | $539.6 | $738.4 |
| Value of State road contract awards | do. | $211.8 | $232.0 | $290.7 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 994 | 1,173 | 1,298 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $299.2 | $361.3 | $409.8 |
| Value per capita | | $76 | $92 | $103 |

[p]Preliminary. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

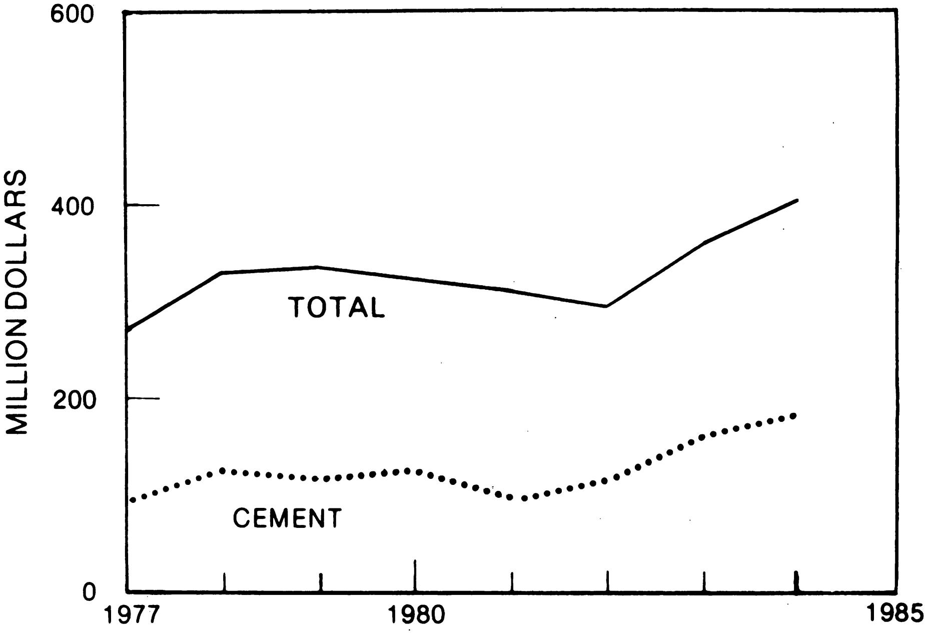

Figure 1.—Value of cement and total value of nonfuel mineral production in Alabama.

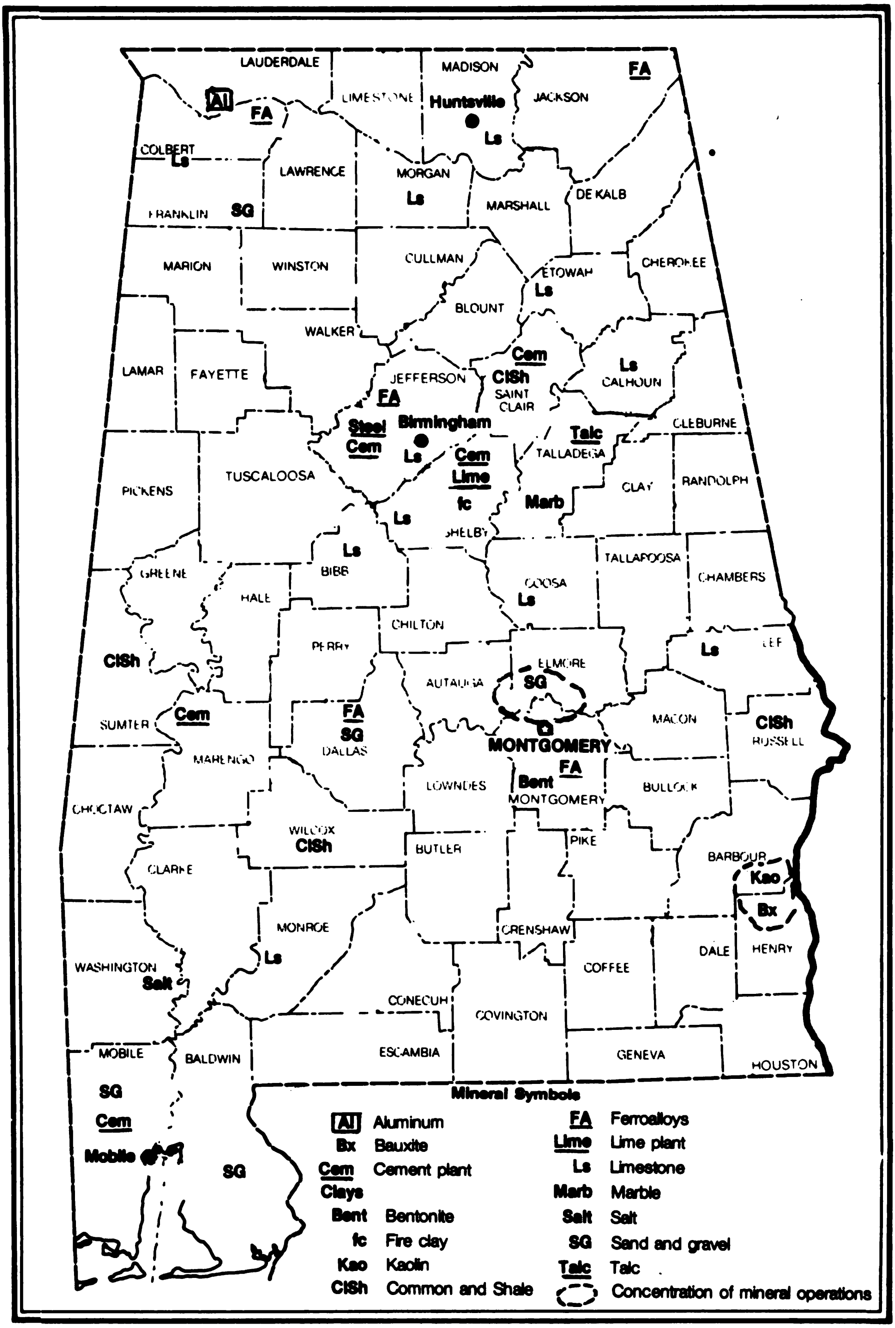

Figure 2.—Principal mineral producing localities in Alabama.

**Trends and Developments.**—A moderate economic recovery, which started late in 1983, continued through 1984, impacting positively on the nonfuels minerals sector. Construction activities increased resulting in a mining employment increase and a reduced unemployment rate, the lowest since 1981. The key to sustained activity will be in highway repair and surfacing and nonresidential construction. The State Highway Department plans to spend $1.6 billion in roadbuilding over the next 5 years. At yearend, Alabama's unemployment rate was 11.6%, down from 12.8% at yearend 1983.

Alabama's economic recovery has been less spectacular than that of other Southeastern States because of the State's closer link to heavy industries, which are susceptible to import competition. The State's unemployment rate, even after 2 years of decline, remained well above the national rate of 7.1%. The uncertainties in the steel and aluminum industries held economic conditions depressed to some degree. Alabama's overall economy is more sensitive to the negative effects of the dollar's high value, resulting in slower growth, which directly affected the mineral industry. The primary metals industry had an increase in employment but the number of jobs remained well below the 1979 peak year.[3] The value of public works construction permits for treatment plants, bridges, and public buildings more than doubled in 1984, with much of the actual construction to begin in 1985. The increased activity in the nonfuel minerals industry was expected to carry over to some extent through 1985.

The Alabama Development Office (ADO), in its 1984 report on new and expanding industries, announced 154 new operations and expansions totaling $259.1 million in mineral-related fields as follows: bituminous coal mining, 2 expansions with a total investment of $370,000; oil and gas, 2 expansions with a total investment of $3.1 million; mining and quarrying of nonmetallic minerals, 1 new operation and 8 expansions with a total investment of $4.1 million; petroleum refining, 1 new operation and 13 expansions with a total investment of $13.7 million; stone, clay, glass, and concrete products, 3 new operations and 47 expansions with a total investment of $59.1 million; and primary metals, 2 new operations and 75 expansions with a total investment of $178.7 million. The number of expansions and total value were slightly higher than announced for 1983.

To assist in economic development, the State historically has encouraged foreign investment. In 1971, 6 foreign-based firms were in operation, but by 1984, more than 70 were present with a total investment of over $2 billion. Countries involved in the nonfuel mineral or related fields were the United Kingdom (cement, lime, industrial gases, and chemicals), the Federal Republic of Germany (cement, ferroalloys, and chemicals), France (cement and precious metals), Japan (steel and aluminum fabrication), Switzerland (chemicals), the Netherlands (chemicals), Mexico (ferroalloys), and Austria (chemicals).

The Alabama State Docks at the Port of Mobile handled over 24 million short tons of material during fiscal year 1984, an increase of nearly 500,000 tons over that of fiscal year 1983. Increases in activity were mainly at the coal export plant and the bulk materials handling plant. The coal export plant, although exporting 8.9 million tons of coal, fell short of projected figures. Recent expansions raised the throughput capacity to 23 million tons annually. Expansions of the bulk materials handling plant included a new rail car dump, dock, reworked storage pad, and a new conveyor system. The major commodity handled was iron ore with over 2 million tons handled. Other bulk raw minerals included manganese (36,143 tons), ilmenite (85,522 tons), rutile (22,026 tons), and potash (207,034 tons). The port also handled cement, gypsum, shell, stone, and sand and gravel. New facilities for handling potash were leased from the Aluminum Co. of America (Alcoa). The Dead Sea Works Ltd., Israel, invested $1.3 million in the facilities to store potash destined for Mississippi Chemical Corp.'s plant in Pascagoula, MS. Plans call for up to 300,000 tons to be imported yearly.

The Tennessee-Tombigbee Waterway was basically completed with the tie-in of the Tennessee and Tombigbee Rivers in December. Barge traffic on the $2 billion waterway was scheduled to begin in January 1985. The Alabama State Docks spent over $230 million to upgrade and expand facilities to handle the expected increase of exports and imports. Minerals and products expected to be shipped through the waterway include coal, metallic ores, nonmetallic ores, primary metals, fabricated metals, clays, cement, and stone. Various mineral producers along the waterway were developing plans to utilize the waterway to reduce costs or develop new market areas.

The Department of Industrial Relations reported that coal production for fiscal year 1984 increased nearly 15% to over 26 million tons. Of the operations, 20 were underground and 154 were surface mines; 5 produced over 1 million tons. Of the total output, 2.7 million tons was used to produce nearly 2 million tons of coke. Alabama coal miners signed a new agreement in August without a strike, the first time a strike did not occur in 18 years.

The State's primary metal industries, although not operating near capacity, started recovery during 1984. United States Steel Corp.'s Fairfield Works, closed since mid-1982, started up early in the year to provide steel to its new seamless pipe plant. Other facilities, including its tin mill, returned to production during the year. LTV Corp., after merging with Republic Steel Corp., agreed to sell its Gulf States Steel Corp. facility at Gadsden. The plant operated at reduced levels, and by yearend, had not been sold. SMI Steel Inc. converted the Connors Steel Co. facilities to a minimill and started operation early in the year. Tuscaloosa Steel Corp. started construction of a $75 million minimill in Tuscaloosa. The 600,000-ton-per-year facility was scheduled to be operational late in 1985. Alabama's aluminum facilities were adversely affected by depressed markets and high energy costs. Reynolds Metals Co., Listerhill, reopened two potlines during the year after being inactive during 1983; closure of one potline was announced late in the year. Revere Copper & Brass Inc., Scottsboro, remained closed during the year. Revere sold its aluminum sheet rolling mill late in the year to Noranda Inc. as part of Revere's reorganization process. The mill produces about 75,000 tons of sheet per year, mainly for the construction industry. Depressed markets and high levels of imports also impacted on the State's foundry and ferroalloy industries. Autlan Manganese Corp., Mobile, permanently shut down its silicomanganese plant because of the depressed steel industry and imports.

Texasgulf Minerals & Metals Inc. started operations in September at its $5 million plasma smelting facility in Anniston. The plant recovers platinum-group metals from automotive exhaust emission catalytic converters. The plant is expected to process 7 million pounds of catalysts annually, producing about 500,000 troy ounces of platinum, 15,000 troy ounces of palladium, and some rhodium.

Sunbelt Chemicals Inc., Atmore, a manufacturer of agricultural and industrial sulfur, announced plans to produce liquid sulfur for the pulp and paper industry. The $500,000 expansion was scheduled for completion early in 1985. Triangle Energy and Chemical Inc. announced plans to build a plant in Troy for the production of emulsified sulfur. The $600,000 project was scheduled for completion late in the year.

**Employment.**—Alabama's average unemployment rate for 1984 was 11.1%, down from 13.7% in 1983. Total employment in the State increased about 5% over that of 1983. Total mineral industry employment increased slightly; both mining and quarrying and coal mining shared in the increase. In mineral-related fields, employment in the stone, clay, and glass sectors increased along with that of the primary metals sector.

**Legislation and Government Programs.**—The Geological Survey of Alabama (GSA) continued comprehensive programs, which included assessment of the mineral, energy, and water resources of the State to determine their quality, character, and capacity for development. GSA provided resource information and evaluations to other State agencies to assist with the acquisition of baseline data upon which sound regulatory decisions could be made. GSA maintained a geochemistry laboratory, a comprehensive earth-science library, a well-cuttings and core sample library, and a geocartographic division, which in 1984 published 50 reports.

Water resource investigations were continued on watersheds in the Warrior Coal Field, the aquifers of southeast Alabama, saltwater encroachment in coastal Alabama, and the influence of coalbed methane development on ground water supplies. Cooperative studies were conducted with the Tennessee Valley Authority (TVA) and the U.S. Geological Survey (USGS). Mineral resource studies were completed on the gibbsite and limestone resources of the State. A report on mica was completed as an initial report in the mineral atlas series. Two reports of the mineral and energy resources of the State were published in the special map series, and fieldwork was begun on studies of carbonate rocks and cobalt-bearing manganese. Energy resource studies included collection of samples of various coalbeds, an inventory of the State's underground coal mines, and a compilation of all available data on Alabama's lignite. Environmental research included the collection of baseline data for utilization in mineral and energy resource investigations. GSA continued progress on its new State geologic map by revising and upgrading existing maps. Work in the Appalachian Plateaus and Interior Low Plateaus was completed and was initiated for the Coastal Plain and Piedmont provinces.

The responsibility of the State Lands Division of the Department of Conservation and Natural Resources is to manage State-owned lands that are not being used for specific purposes. The division has six nonfuel mineral leases in State rivers and Mobile Bay. Royalty rates ranged from 22 to 26 cents per cubic yard of sand and gravel; royalty rates for oyster shell were 30 cents per cubic yard. In fiscal year 1984, royalty payments for sand and gravel were $200,000, up from $125,000 in 1983; oyster shell royalties were nearly $40,000. In August, State representatives received 58 bids for oil and gas leases to State-owned submerged lands in Mobile Bay, Mississippi Sound, and the Gulf of Mexico. The 18 high bids accepted netted the State nearly $350 million.

TVA's ammonia-from-coal facility at Muscle Shoals successfully completed a run on coal liquefaction residue. About 4,000 tons of residue produced at Baytown, TX, was used to demonstrate production of synthesis gas. TVA's operations were to demonstrate that the carbon in the residue could be converted to usable gaseous products.

The Mineral Resource Institute of the University of Alabama at Tuscaloosa received funding from the U.S. Bureau of Mines during fiscal year 1984 to encourage the training of mining engineers and other scientists involved in mineral-related studies and to continue the research in mineral exploration, mining, processing, utilization, and conservation. Primary emphases were on energy-related projects, but nonfuel research was also conducted on metallic and nonmetallic mineral resources. Ongoing work included oil shale characterization and beneficiation, study of crib design for coal mine roof control, flotation studies of various minerals, and a study of the Alabama tin belt. Publications during the year included a bibliography on surface mine blasting and an investigation of the effects of surface blasting on underground mine roof stability.

USGS continued its cooperative agreement with GSA in regard to water resource investigations. In the State, USGS continued to work on manganese resources, studies of the origins of natural gas, petrology and reservoir characteristics of deeply buried clastic rocks, geology of bitumen deposits, and gulf coast lignite. USGS published Professional Paper 1300, "Wilderness Mineral Potential." Included in the report were three areas in the State: Adams Gap and Shinbone Creek Roadless Areas; Big Sandy, West Elliotts Creek, and Reed Brake Roadless Areas; and Sipsey Wilderness and Additions These studies were prepared in cooperation with the U.S. Bureau of Mines.

In fiscal year 1984, the U.S. Bureau of Mines had several contracts in the State. Wyle Laboratories and Aaberg & Associates, Huntsville, were recipients of nine contracts totaling over $600,000. Research activities centered on noise control, machine redesign concepts, and coal interface detector investigations. The GSA had a small contract to assess the cobalt-bearing manganese deposits in the Alabama Piedmont.

The U.S. Bureau of Mines Tuscaloosa Research Center conducted several mineral-related projects in Alabama. Among them were (1) recycling of zircon from investment casting molds, (2) development of chemical binders to increase mine roof stability, (3) dewatering of coal-clay wastes, and (4) basic clay testing in cooperation with various State agencies. Report of Investigation (RI) 8910, "Centrifugally Cast Glass-Ceramic Pipe From Mining and Processing Wastes," was the result of research at Tuscaloosa. Other selected publications pertinent to the State included RI 8868, "In-Line Aeration and Treatment of Acid Mine Drainage," and Information Circular 8992, "Use of Steel Sets in Underground Coal."

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

Nonmetals accounted for the bulk of the value of Alabama's total nonfuel mineral production. Construction minerals output increased primarily because of increased construction activity. Increase in primary metals and automotive output had a positive effect on other nonfuel minerals in the State.

**Abrasives (Manufactured).**—Artificial abrasives were manufactured by one company in Madison County. Abrasive-grade, high-purity fused aluminum oxide and aluminum zirconium oxide were produced by Norton Co. in Huntsville.

**Cement.**—Cement accounted for over one-third of the value of nonmetallic minerals produced in Alabama, with both masonry and portland cements being produced. Nationally, Alabama ranked fifth and sixth in the production of masonry and portland cement, respectively. Production and value of both types of cement increased, with portland production reaching its highest level in over 10 years. Unit prices of portland cement decreased while that of masonry cement increased.

Portland cement was produced at six plants in Alabama, two in Jefferson County and one each in Marengo, Mobile, St. Clair, and Shelby Counties. Five plants used the dry process while Allied Products Co. used the wet process. The six companies operated eight kilns with a total daily clinker capacity of 13,800 tons. Seven plants produced masonry cement, with Cheney Lime & Cement Co. being one of two plants nationally that produced masonry cement exclusively. The record high output was achieved despite a month-long strike and lengthy maintenance shutdowns at some plants. Of the six companies operating, four are owned by foreign companies. Major end uses for portland cement were concrete products, ready-mixed concrete, building materials, and highway construction. Principal raw materials used in making cement included cement rock, chalk, clays, gypsum, iron ore, limestone, sand, and shale; coal was also used as a fuel.

Ideal Basic Industries Inc. curtailed kiln operations at its plant in Theodore to complete an $18 million program to improve efficiency. The shutdown was expected to last until mid-1985 with deliveries being made from inventories and purchased supplies. Since its opening in 1982, the plant, with the exception of a brief period in 1984, has operated at only 60% of its 1.5-million-ton-per-year capacity. High moisture content in the limestone from Ideal's quarry near Monroeville was cited as the major reason for low production. Modifications included a second raw mill system, changes in rotary drying, and the addition of a secondary crushing system. Ideal was also negotiating to acquire limestone from the Dominican Republic where it would install a primary crushing system. The drier limestone would allow Ideal to increase capacity to 1.6 million tons per year and reduce fuel costs by 40% with payback anticipated on the $18 million project in less than 2 years. The Monroeville quarry would be maintained on a standby basis.

Lehigh Portland Cement Co., Leeds, underwent considerable modification and renovation work over the last 2 years at a cost of $15 million. Modifications increased kiln capacity from 1,800 to 2,000 tons per day. Lehigh is presently buying a portion of its clay requirements with plans to develop its own clay pit within the next 2 years. Improvements in 1984 included a new grinding mill and clay handling facilities on the quarry floor to mix clay with stone.

Blue Circle Inc., Roberta, was utilizing petroleum coke from the Chicago area to supplement fuel needs. The coke was mixed at a rate of 45% to 55% coal in Blue Circle's kilns. Fuel costs were reportedly reduced about 15 to 20 cents per million British thermal units.

National Cement Co. Inc., Ragland, announced a $4 million expansion program through ADO.

Lohja Corp. of Finland acquired Southern Ready Mix Inc., Alabama's largest producer of ready-mixed concrete. Southern has five plants in Birmingham, four in Mobile, three in Baldwin County, a stone operation in Calera, and a sand and gravel operation in Selma.

**Table 4.—Alabama: Masonry cement salient statistics**

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 5 | 7 |
| Production | 205,121 | 236,274 |
| Shipments from mills: | | |
| Quantity | 210,394 | 258,831 |
| Value | $13,416,694 | $17,247,161 |
| Stocks at mills, Dec. 31 | 27,692 | 29,341 |

**Table 5.—Alabama: Portland cement salient statistics**

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 6 | 6 |
| Production | 3,195,141 | 3,677,767 |
| Shipments from mills: | | |
| Quantity | 3,279,393 | 3,656,445 |
| Value | $150,254,922 | $167,191,212 |
| Stocks at mills, Dec. 31 | 367,119 | 389,730 |

**Clays.**—The State's clay industry produced common clay, fire clay, bentonite, and kaolin. Output and value of total clays increased and paralleled the rise in economic activity in the State and region. Alabama ranked third nationally in the preduction of fire clay and kaolin, and fourth in bentonite. Clays ranked fourth in mineral value in Alabama in 1984 as 22 companies mined clay at 38 pits in 18 counties.

Common clay was mined by 14 companies at 21 pits in 13 counties. Leading counties were Jefferson, Russell, and Sumter. Production and value decreased; major uses were brick, cement, and concrete block.

Henry Brick Co., Selma, was in the third phase of its modernization program with a clay preparation project. The company contracted with Agemac to build a $1 million clay preparation facility for raw material storage and preparation equipment. The first two phases of modernization were conversion of the two plants from gas to wood chips as fuel; the third phase, the preparation project, was scheduled for completion early in 1985.

N. K. Industries Inc. announced the opening of a $600,000 crushing and grinding plant at Phenix City. The facility will custom grind chromite and manganese ores for the brick industry. Five companies announced expansions through ADO totaling nearly $3 million. Two of the companies were producers of refractory clay.

Vulcan Materials Co.'s Parkwood lightweight aggregate plant operated at about 50% capacity, closing late in 1984 with scheduled reopening in April 1985. Competing lightweight aggregate plants in Alabama, Georgia, Mississippi, and Tennessee have restricted Vulcan's market area.

Fire clay was mined by four companies at six pits in Calhoun, St. Clair, and Shelby Counties. Production increased slightly while value decreased. American Colloid Co. mined bentonite at its operation in Lowndes County for use in drilling muds and the foundry industry; production increased. The company operated three pits where the material was dried, crushed, and shipped to markets nationwide. Of the two kilns in operation, one was gas fired and the other was converted to coal and/or wood.

Kaolin was mined by 3 companies at 10 pits in Barbour and Henry Counties. Production and value increased significantly. Major uses were in firebrick and other refractories. Kaolin occurs in association with bauxite, which was also used for refractory purposes. Mining companies continued to operate at reduced levels during the year.

**Fluorspar.**—International Minerals & Chemical Corp. operated a fluosilicic acid plant at Florence. 3M Corp.'s Specialty Chemicals Div. operated a plant at Decatur, brought on-stream in 1983, to manufacture chemical-resistant products for the rubber industry. The company manufactured a fluoroelastomer used in nonmetallic ducting-system expansion joints for pollution control and a general purpose gumstock without curatives.

**Lime.**—Alabama ranked fifth nationally in the production of lime, which was the third leading commodity, valuewise, produced in the State in 1984. Production increased and exceeded 1 million short tons for the first time since 1981. Lime was produced by four companies in five plants in Shelby County. Both quicklime and hydrated lime output increased with unit values also increasing. Production increased as demand in the steel and paper industries and for use in sewage and industrial waste treatment increased. One of Allied's two plants, closed during 1983, reopened in mid-1984 to meet demand. The Longview plant of S. I. Lime Co. was the eighth leading plant in total output in 1984.

**Table 6.—Alabama: Lime sold or used by producers, by use**

| Use | 1983 Quantity (short tons) | 1983 Value (thousands) | 1984 Quantity (short tons) | 1984 Value (thousands) |
|---|---|---|---|---|
| Paper and pulp | 218,457 | $9,402 | 371,450 | $15,937 |
| Water purification | 208,808 | 7,699 | 176,742 | 7,599 |
| Sewage treatment | 53,114 | 2,679 | 77,078 | 3,954 |
| Road and soil stabilization | 27,884 | 1,162 | 25,239 | 1,071 |
| Sugar refining | W | W | 10,851 | 642 |
| Other[1] | [r]473,192 | [r]20,207 | 501,956 | 21,357 |
| Total | 981,455 | 41,149 | 1,163,316 | 50,560 |

[r]Revised. W Withheld to avoid disclosing company proprietary data.

[1] Includes acid water neutralization, agriculture, alkalies (1984), animal and human food, aluminum and bauxite, basic oxygen steel, coke and gas (1983), copper ore concentration (1983), electric steel, fertilizer (1984), finishing lime (1984), magnesia from seawater or brine, mason's lime, open-hearth steel (1984), other ore concentration (1983), other chemical and industrial uses, other construction lime (1984), petroleum refining, rubber (1984), sulfur removal from stack gases, tanning, and use indicated by symbol W.

**Mullite (Synthetic).**—Synthetic mullite was produced by Harbison-Walker Refractories Co. Inc. at Eufaula. The output, a high-temperature sintered variety, was used primarily for the manufacture of refractories, with demand increasing as the operation level of the steel industry increased. Production and value were estimated to have increased with unit value also increasing. Synthetic mullite is a product of sintering a mixture of aluminous and siliceous material.

**Nitrogen.**—TVA, Muscle Shoals, and U.S.S. Agri-Chemicals Inc., Cherokee, produced anhydrous ammonia. TVA's plant had an annual capacity of 74,000 short tons, while U.S.S. Agri-Chemicals had a capacity of 175,000 short tons. The Alabama Directory of Mining and Manufacturers also listed Estech Corp. in Dothan and Hercules Inc. in Bessemer as having anhydrous ammonia in its product line.

**Perlite (Expanded).**—Two plants, W. R. Grace & Co., Birmingham, and National Gypsum Co., Mobile, expanded perlite from ore shipped in from the Western United States. Production and value decreased 29% and 20%, respectively. The expanded perlite was used for formed products, horticulture purposes, and concrete aggregate.

**Salt.**—Alabama ranked 10th nationally in the production of salt. Olin Corp., in Washington County, produced salt from brine wells by solution mining a near-surface salt dome. Olin produces three basic products, chlorine, sodium hydroxide, and sodium chlorate, at the facility. Production and value of salt increased with a slight increase in unit value. The salt was used in chemical manufacture, chiefly caustic soda, chlorinated organics, and sodium chlorate and hypochlorite. Olin announced it would convert to membrane cells using technology licensed from Kanegafuchi Chemical Industry of Japan. A portion of the solid salt produced was shipped to Olin's chloralkali plant in Augusta, GA.

**Sand and Gravel.**—Alabama produced both construction and industrial sand and gravel in 1984. Production was from 72 companies producing from 86 operations in 32 counties. Total output increased over that of 1983, but it was still below the record high output during the late 1970's.

Both construction and industrial sand and gravel were shipped into Georgia, mainly the Atlanta area. Eight sand and five gravel operations have met the Georgia Department of Transportation (DOT) requirements for use of materials in DOT projects. The majority of these approved operations are in the Montgomery area.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

**Table 7.—Alabama: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 4,447 | $12,362 | $2.78 |
| Plaster and gunite sands | W | W | 2.96 |
| Concrete products | 232 | 697 | 3.01 |
| Asphaltic concrete | 585 | 1,279 | 2.19 |
| Road base and coverings | 1,558 | 3,559 | 2.29 |
| Fill | 227 | 267 | 1.18 |
| Snow and ice control | W | W | 3.70 |
| Other[1] | 3,301 | 8,024 | 2.43 |
| Total or average | [2]10,348 | 26,188 | 2.53 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes roofing granules, other unspecified uses, and uses indicated by symbol W.

[2] Data do not add to total shown because of independent rounding.

Construction sand and gravel was the fifth leading commodity in value among the nonfuel minerals produced in Alabama. The increase in 1984 was basically due to a surge in construction activities, mainly highway work; residential construction decreased in the last 6 months of the year. Many sand and gravel facilities operated intermittently during the year, depending on proximity and extent of area construction activities. Most operations were relatively small with no individual pit producing more than 1.5 million short tons. Construction sand and gravel was produced at 83 operations in 31 counties. Leading counties were Montgomery, Mobile, Elmore, and Macon. The major portion of sand and gravel was shipped by truck, with lesser amounts transported by rail and water. The top 20 companies, with 29 operations, produced 75% of the construction sand and gravel. Three sand and gravel operations announced expansion plans through ADO totaling $300,000.

*Industrial.*—Five companies produced industrial sand and gravel with output increasing. Industrial sand and gravel was used primarily by foundries for molds and cores. Production for use at silicon alloy plants increased as Ohio Ferro-Alloys Corp. started up its third furnace late in the year. All industrial sand and gravel producers were relatively small with individual output under 200,000 short tons per year.

**Slag—Iron and Steel.**—Alabama was 1 of 22 States that reported processing and utilization of iron and steel slag. Jim Walter Resources Inc., Birmingham, and Vulcan, Fairfield and Gadsden, air-cooled blast furnace slag, which is typically used as road base, railroad ballast, and asphaltic concrete aggregate. Vulcan sold steel slag for similar uses. Total output and value increased 14.6% and 17.9%, respectively, over that of 1983. Output of iron slag decreased while that of steel slag increased, with unit values of both increasing.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Crushed stone ranked second in mineral value in Alabama with output estimated to have increased over that of 1983. Kinds of stone mined included limestone, dolomite, marble, and granite. Alabama led the Nation in 1983 in output of crushed marble. Crushed stone was used primarily in cement manufacture, in concrete, and as a road base. Leading producing counties in 1983 were Shelby, Jefferson, and Colbert. The Alabama Department of Industrial Relations estimates that in fiscal year ending September 30, 1984, about 28.7 million short tons of crushed stone was produced; nine quarries produced in excess of 1 million tons. Most companies increased output because of increased construction activities; several remained closed or operated intermittently because construction activities were out of their marketing areas. Ideal put its Perdue Hill quarry on standby because of high moisture content and plans to import stone from the Dominican Republic for use in its cement plant at Theodore. Vulcan, the major crushed stone producer in the State with 12 operations, purchased Citadel Cement Corp.'s quarry in Birmingham and another in Madison County. Vulcan plans to develop another quarry in the Childersburg area. Southern Stone Co. Inc., the second largest producer in the State, increased output because of increased demand for construction and highway work. Southern began importing aggregates from Mexico and the Caribbean area to expand its product line to include high-quality lime aggregates.

The conversion of the domestic paper industry to alkaline sizing impacted favorably on the marble industry in Sylacauga. Georgia Marble Co. has ultrafine grinding facilities at Tate, GA, for use in the paper industry. Moretti-Harrah Marble Co. completed a $7 million fine and ultrafine grinding facility during the year to meet the needs of the paper industry. The company initiated a major drilling program to delineate reserves for the next 20 years. Although dimension marble was also produced, 85% of its output was from the calcium carbonate operations. Thompson-Weinman Co. completed its ultrafine grinding facility early in the year and produced material for the paper industry. With expansions at several facilities, the market for ultrafine material was becoming very competitive. ADO reported four other expansions at crushed stone operations totaling over $1 million.

*Dimension.*—Production of dimension stone increased slightly with value remaining at about the same level as that of 1983. Alabama ranked fourth nationally in output of dimension marble. Marble was quarried in Talladega County, limestone was mined from an underground operation in Franklin County, and sandstone was quarried in Blount County. Moretti-Harrah, Sylacauga, was modernizing its dimension marble plant, mainly through automation and more modern equipment. Scheduled to go on-stream late in December, the plant will produce small items such as floor tile; large monumental finishing will continue to be done by other companies. Alabama Limestone Inc., Franklin County, was one of the top producers of dimension limestone in the Nation.

**Sulfur (Recovered).**—Alabama ranked fifth nationally in output of recovered sulfur. Two companies recovered sulfur from natural gas processing plants in Escambia and Washington Counties. Two other companies recovered sulfur from petroleum refineries in Mobile and Tuscaloosa Counties. Exxon Co., Hunt Oil Co., Phillips Petroleum Co., and Union Oil Co. sold 380,000 metric tons valued at $34.5 million, a decrease of about 5% in quantity and value from that of 1983, the second straight year of decreased output. Construction started on a $12 million gas separation plant in Washington County with completion scheduled for late in the year. The Coillet Oil Venture Co.'s facility in Copeland will be operated by Panther Hydrocarbon Corp. The plant, utilizing the cryogenic process, will have a capacity of 114 tons per day of sulfur.

**Talc.**—Cyprus Industrial Minerals Co. ground talc from out of State at its plant near Alpine; output and unit prices increased over that of 1983. The product was used primarily in paper, cosmetics, paint, plastic, rubber, and ceramics.

**Vermiculite (Exfoliated).**—W. R. Grace & Co., Jefferson County, exfoliated vermiculite at its plant in Irondale from crude ore shipped into Alabama. Primary uses were in concrete aggregate, block, loose fill insulation, and as a sand conditioner. Production and value increased over that of 1983.

## METALS

Primary metal production was one of the most important industries in the State. Most of the State's adverse economic conditions can be traced to a downward trend in the metals industry, which started in 1979 and continued into 1984. The national recession and imports contributed to the decline in activities in the metals industry. The industry in Alabama consists of aluminum, ferroalloys, steel, and various foundries, with aluminum being impacted more than the others.

**Aluminum.**—Alabama was 1 of 17 States with primary aluminum production facilities. Two companies, Revere in Scottsboro and Reynolds in Sheffield, have facilities for producing aluminum. Reynolds operated at a reduced level while Revere was shut down for the second straight year. Both facilities were considered high unit cost operations because of power costs. Reynolds restarted one potline early in the year and a second in March, resulting in an operating rate of about 40%. Discounted electric rates, increased demand, and decreased inventories prompted the decision. Late in the year, Reynolds announced one potline would be shut down early in 1985. Reynolds completed shutdown of its aging wire, rod, and bar operations in March, and announced completion of the $14 million modernization and renovation of its five-stand cold-rolling mill. Reynolds' Southern Reclamation Co. started construction of a $10 million, 50,000-ton-per-year secondary aluminum smelting and refining plant. The construction, which includes renovation and installation of new equipment at the old Union Carbide facility, was scheduled for completion in 1985. Revere, closed since 1982, sold its rolling mill at Scottsboro to Noranda as part of Revere's reorganization process. Revere, which filed for protection from its creditors under chapter 11 of the Bankruptcy Code, indicated the sale was expected to be completed in January 1985. Noranda was expected to ship ingots from its smelter in New Madrid, MO, to the 75,000-ton-per-year rolling mill. At midyear, Revere announced that the bankruptcy court approved settlement of suits with TVA and Alcoa. Under the settlements, TVA will be allowed claims of $32.2 million for power contracts, and Alcoa, $20 million for alumina contracts.

Ford Motor Co., Sheffield, rejected an offer to sell its idle aluminum casting plant to Accurate Die-Casting Co. of Cleveland, OH. The plant was closed in 1983 because of high operating costs.

Kaiser Aluminum & Chemical Corp. reopened its wire and cable plant in Bay Minette after a 90-day shutdown because of wage renegotiations. A negotiated settlement guarantees the plant will remain open for at least 2 years. The agreement called for a reduction in wages and benefits. Alcoa permanently closed its alumina facility at Mobile during the year resulting in a $41 million write-down. The plant had been idle since early 1982 owing to an oversupply of alumina and high operating costs at the facility.

**Bauxite.**—Alabama ranked second nationally in bauxite production. Four companies mined bauxite in Barbour and Henry Counties for use in refractories and chemical manufacture. Production and value increased to some extent but still remained at very low levels; unit prices increased. All producers operated intermittently and at low levels of capacity during 1984. Dresser Industries Inc., Eufaula, which completed its ceramic proppant plant late in 1983, produced proppants from bauxitic clays. The proppants were used in the petroleum industry in oil well development.

**Ferroalloys.**—Alabama ranked fourth nationally in shipments of ferroalloys, with output and value increasing 9.6% and 23.2%, respectively. Although increasing, output still was well below levels in the late 1970's. Products included ferrosilicon, silicomanganese, and silicon metal. During the year, many of the ferroalloy plants remained closed or operated at reduced levels. Autlan, which ceased production in July 1982, permanently closed its silicomanganese plant in Mobile. Cited as primary reason for the shutdown was low-priced imports. The closure caused a permanent loss of about 20% of the Nation's silicomanganese capacity.

Pickands Mather & Co. purchased Interlake Inc.'s Globe Metallurgical Div. for $37 million. Globe operated a 22,000-ton-per-year silicon metal plant at Selma. Globe announced a $157,000 expansion project at its Selma facility. Ohio Ferro-Alloys closed its Philo, OH, plant to concentrate its efforts on silicon metal production at its Mount Meigs plant near Montgomery. The Mount Meigs facility operated two furnaces utilizing gravel mined locally. Late in the year, the company started up its third furnace, mainly to meet the demand previously supplied by the closed facility in Ohio. The company produced a chemical-grade silicon metal and a higher calcium-grade material for the aluminum industry. The Mount Meigs facility is the newest and reportedly the most efficient of the company's plants. The shift away from ferroalloy production was caused by low-priced imports from Brazil and the U.S.S.R.

**Gold.**—Developments in Alabama were generally restricted to recreational gold mining with some exploration by various corporations. Several thousand acres have been leased by individuals and mineral companies in Cleburne County. Other counties reporting leasing were Clay, Randolph, Talladega, and Tallapoosa, mostly in areas of old abandoned base metal mines. Some drilling has been done with no reported results.

**Iron and Steel.**—Alabama was 1 of 12 States that produced pig iron; shipments more than doubled over that of 1983 along with an increase in unit values. Gulf States Steel, Gadsden, and U.S. Steel, Fairfield, were the major iron and steel companies.

U.S. Steel started up its new 600,000-ton-per-year seamless pipe mill at Fairfield using blooms from Armco Inc.'s Ashland, KY, plant. During the year, the mill was shut down on two occasions owing to lack of orders; cited was the report that 70% of the seamless domestic market was supplied by imports. U.S. Steel restarted its smaller No. 7 blast furnace and two basic oxygen furnaces early in the year, down since mid-1982, to supply the new pipe mill. The company's tin mill, also closed since mid-1982, was reopened in November. Reasons cited were that Fairfield steelworks produced more steel than it used and that the tin mill had a double cold-rolled reduction mill that gave it a wider product mix. The company announced late in the year that the No. 8 blast furnace would be started up early in 1985, replacing the smaller No. 7 blast furnace. The coke oven remained shut down with plans to reopen in 1985. Construction of a new $200 million continuous slab caster was expected to begin early in 1985 with scheduled completion in 1986. During the last 10 years, U.S. Steel has expended more than $1.3 billion to modernize facilities at Fairfield. Recent additions included the seamless pipe mill, a continuous bloom caster, a 5,000-ton-per-day blast furnace, and three Q-bops. With the addition of the new continuous caster in 1986, the plant will be able to feed its flat-rolled finishing operations as well as its pipemaking operations. Fairfield has a capacity of 3 million tons per year, but this level of operations is not expected in the near future.

LTV, which merged with Republic Steel early in the year, continued efforts to divest itself of the Gadsden operations by December 1 as decreed by a Federal court. At midyear, the plant was operating its plate and hot strip mills on alternate 2-week schedules. LTV, unable to divest itself of the plant by the deadline, formed a new independent company, Gulf States Steel, to run the operations. In addition, Oppenheimer & Co. was appointed trustee to handle the sale of the facilities. A State legislative panel was appointed to assist officials in finding a new owner. Among interested parties was the local United Steelworkers of America union, which hired a consultant to conduct a feasibility study to determine the possibility of partial ownership. The Gadsden Works produced carbon and high-strength, low-alloy hot plate and sheet. The plant reportedly lost $46.6 million in 1983 and $22.0 million in 1984; the last profitable year was 1981. Shipments increased from 674,000 tons in 1983 to 711,000 tons in 1984.

SMI announced a startup early in the year of the former Connors Steel facility in Birmingham as a minimill. SMI will produce about 250,000 tons per year of carbon steel. The melt shop started operations in March; the rolling mill started up in April. The plant operated at two turns at yearend with plans to go to three turns in 1985. SMI concluded a $9 million long-term Industrial Development Revenue Bond agreement to modernize and upgrade facilities.

Tuscaloosa Steel began construction of a 600,000-ton-per-year flat roll minimill in Tuscaloosa. The $75 million facility was scheduled for completion by early 1986. The facility will have the capability to produce hot-rolled preducts of varying sizes, grades, and widths. A key element in the project will be a 112-inch wide, coiled plate mill. High-quality semifinished slab will be imported for use at the facility; reportedly, the slab is not available in the United States.

Mitsubishi International Corp., a subsidiary of Mitsubishi Corp. of Japan, planned to open a $5 million steel processing facility at Athens by yearend. The facility will process about 80,000 tons of coiled steel per year with about 20% going to Japanese firms in the area.

*Ferrous Foundries.*—Iron and steel foundries were a vital industry that affected mineral producers in the State and region. Most foundries, however, have been adversely affected by poor economic conditions. Raw materials utilized included scrap, clay, limestone, and sand, most of which came from sources in the region. The Alabama Directory of Mining and Manufacturing listed 43 gray iron foundries, 27 steel foundries, 8 steel investment foundries, and 2 malleable iron foundries. Alabama Ductile Iron Co. (ADICO), Brewton, and Wagner Casting Co., Decatur, IL, formed a partnership to expand ADICO's plant capacity from 12,000 to 25,000 tons per year. The $3 million project was scheduled for completion late in 1984 and will produce ductile and gray iron castings. Citation Carolina Corp., Birmingham, acquired Simsco Inc., which has three ductile iron foundries along with supporting facilities in central Alabama. Citation is also the parent company of Southern Ductile Casting Co. of Bessemer. ADO announced 18 other expansion projects at foundries in Alabama in 1984. Total expenditures for the projects was reportedly $15.5 million.

**Rutile (Synthetic).**—Kerr-McGee Corp., Mobile, operated its synthetic rutile plant with output shipped to Hamilton, MS, for processing to titanium dioxide pigments. Ilmenite from Australia was used as feed material for the synthetic rutile plant; about 85,000 short tons was imported through the Port of Mobile. The plant has a capacity of 110,000 tons per year.

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] State geologist, Geological Survey of Alabama, Tuscaloosa, AL.

[3] Federal Reserve Bank of Atlanta. Economic Review. Feb. 1985, pp. 58-68.

## Table 8.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum smelters: | | | |
| Revere Copper & Brass Inc | Box 191<br>Rome, NY 13440 | Plant | Jackson. |
| Reynolds Metals Co | Reynolds Metals Bldg.<br>Richmond, VA 23218 | do | Colbert. |
| Bauxite: | | | |
| A. P. Green Refractories Co.,[1] a subsidiary of United States Gypsum Co. | Mexico, MO 65265 | Mine and plant | Barbour. |
| Harbison-Walker Refractories Co. Inc.,[2] a division of Dresser Industries Inc. | Dale Rd.<br>Route 1, Box 58<br>Eufaula, AL 36027 | do | Barbour and Henry. |
| Mullite Co. of America | 901 East 8th Ave.<br>King of Prussia, PA 19406 | Mine | Henry. |
| Cement: | | | |
| Allied Products Co.[3] | Box 36130<br>Birmingham, AL 35236 | Plant | Jefferson. |
| Blue Circle Inc.[4] | 18th Floor, Daniel Bldg.<br>Birmingham, AL 35233 | do | Shelby. |
| Citadel Cement Corp | 2625 Cumberland Pkwy. NW.<br>Atlanta, GA 30339 | do | Marengo. |
| Ideal Basic Industries Inc.[4] | 950 17th St.<br>Box 8789<br>Denver, CO 80201 | Plants | Mobile. |
| Lehigh Portland Cement Co | 800 2d Ave., South<br>Leeds, AL 35094 | Plant | Jefferson. |
| National Cement Co. Inc | Drawer A<br>Ragland, AL 35131 | do | St. Clair. |
| Clays: | | | |
| Bickerstaff Clay Products Co. Inc | Box 517<br>Bessemer, AL 35020 | Mines | Jefferson and Russell. |
| Blue Circle Inc | 18th Floor, Daniel Bldg.<br>Birmingham, AL 35233 | Mine | Shelby. |
| Jenkins Brick Co | Box 91<br>Montgomery, AL 37101 | Mines | Chilton and Elmore. |
| Tombigbee Lightweight Aggregate Corp., a division of Breeko Industries Inc. | Box V<br>Livingston, AL 35470 | Mine | Sumter. |
| Ferroalloys: | | | |
| Moore McCormack Resources Inc., Globe Metallurgical Div. | Box 348<br>Selma, AL 36701 | Electric furnace | Dallas. |
| International Minerals & Chemical Corp., TAC Alloys Div. | Garner Rd.<br>Bridgeport, AL 35740 | do | Jackson. |
| Ohio Ferro-Alloys Corp | Box 68<br>Montgomery, AL 36057 | do | Montgomery. |
| Reynolds Metals Co | Box 191<br>Sheffield, AL 35660 | do | Colbert. |
| Lime: | | | |
| Allied Products Co | Box 36130<br>Birmingham, AL 35236 | Plants | Shelby. |
| Blue Circle Inc.[4] | 18th Floor, Daniel Bldg.<br>Birmingham, AL 35233 | Plant | Do. |
| Cheney Lime & Cement Co | Allgood, AL 35013 | do | Do. |
| S. I. Lime Co | Suite 204<br>Three Riverchase Office Plaza<br>Birmingham, AL 35244 | do | Do. |
| Pig iron: | | | |
| Jim Walter Resources Inc | 330 1st Ave., North<br>Birmingham, AL 35202 | Furnaces | Jefferson. |
| Gulf States Steel Corp | 174 South 26th St.<br>Gadsden, AL 35901 | Furnaces and mills. | Etowah and Jefferson. |
| United States Steel Corp | Box 599<br>Fairfield, AL 35064 | do | Jefferson. |
| Salt: | | | |
| Olin Corp | 120 Long Ridge Rd.<br>Stamford, CT 06904 | Brine wells | Washington. |
| Sand and gravel: | | | |
| Holland and Woodward Co. Inc | Box 1947<br>Decatur, AL 35601 | Surface mine and plant. | Franklin. |
| R & S Materials Inc | Box 3547<br>Montgomery, AL 36109 | Surface mines and plants. | Autauga, Elmore, Macon, Montgomery. |
| Southern Industries, Radcliff Materials. | Drawer 2068<br>Mobile, AL 36601 | do | Mobile and Montgomery. |
| C. T. Thackston | Box 3211<br>Montgomery, AL 36109 | Surface mine and plant. | Montgomery. |

See footnotes at end of table.

### Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Stone: | | | |
| Allied Products Co | Box 628<br>Alabaster, AL 35007 | Quarries | Shelby. |
| Hoover Inc | Box 17346<br>Nashville, TN 37217 | do | Colbert and Jackson. |
| Ideal Basic Industries Inc | 950 17th St.<br>Box 8789<br>Denver, CO 80201 | Quarry | Monroe. |
| Southern Stone Co. Inc.[5] | Box C-200<br>Birmingham, AL 35283 | Quarries | Bibb, Colbert, Lee, Shelby. |
| Vulcan Materials Co.[6] | Box 7324-A<br>Birmingham, AL 35253 | do | Calhoun, Colbert, Etowah, Franklin, Jackson, Madison, Shelby. |
| Talc: | | | |
| Cyprus Industrial Minerals Co | Alpine, AL 35014 | Plant | Talladega. |

[1] Also kaolin.
[2] Also kaolin and synthetic mullite.
[3] Also lime.
[4] Also clays and stone.
[5] Also sand and gravel.
[6] Also clays and sand and gravel.

# The Mineral Industry of Alaska

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Division of Geological and Geophysical Surveys, Alaska Department of Natural Resources, for collecting information on all nonfuel minerals.**

## By Tom L. Pittman[1]

The value of nonfuel mineral production reported in Alaska in 1984 was $88.7 million; in 1983, the value was $124.5 million. The decrease in 1984 was due to lesser values for gold and construction sand and gravel. No production of antimony, mercury, or platinum-group metals was reported in 1984. Alaska ranked 42d in the United States in nonfuel mineral production.

**Table 1.—Nonfuel mineral production in Alaska[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Gem stones | NA | $60 | NA | $60 |
| Gold (recoverable content of ores, etc.) troy ounces | [r]39,523 | [r]16,758 | 23,232 | 8,379 |
| Sand and gravel (construction) thousand short tons | [e]45,200 | [e]97,200 | 30,861 | 66,883 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 4 | 47 | W | W |
| Stone (crushed) thousand short tons | 1,981 | 9,460 | [e]2,500 | [e]10,800 |
| Combined value of cement (portland, 1984), copper (1983), lead (1983), tin, and value indicated by symbol W | XX | 971 | XX | 2,561 |
| Total | XX | [r]124,496 | XX | 88,683 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Alaska, by region[1]

(Thousands)

| Region | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Alaska Peninsula | (2) | $75 | Stone (crushed). |
| Cook Inlet-Susitna | W | 761 | Stone (crushed), gold, silver, copper, lead. |
| Copper River | W | W | Gold, stone (crushed). |
| Kenai Peninsula | W | (3) | |
| Kodiak | W | (3) | |
| Kuskokwim | $1,072 | -- | |
| Northern Alaska | 10 | (3) | |
| Seward Peninsula | W | W | Gold, tin, silver. |
| Southeastern Alaska | W | 8,077 | Stone (crushed), gold, silver, copper, lead. |
| Yukon River | W | 8,055 | Gold, stone (crushed), silver. |
| Undistributed[4] | 86,630 | 10,330 | |
| Sand and gravel (construction) | XX | [e]97,200 | |
| Stone (crushed) | [e]25,200 | XX | |
| Total[5] | 112,911 | 124,496 | |

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for regions not listed.

[2] Crushed stone was produced; data not available by region. Total State value is shown separately under "Stone (crushed)."

[3] Construction sand and gravel was produced; data not available by region. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones and some construction sand and gravel that cannot be assigned to specific regions and values indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Alaska business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 444 | 481 | 500 |
| Total civilian labor force | do | 211 | 234 | 245 |
| Unemployment | do | 21 | 24 | 25 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 8.9 | 8.2 | 8.8 |
| Metal mining[2] | do | .6 | .6 | NA |
| Nonmetallic minerals except fuels[2] | do | .1 | .1 | NA |
| Coal mining[2] | do | .1 | .1 | NA |
| Oil and gas extraction[2] | do | 8.3 | 7.5 | NA |
| Manufacturing total | do | 12.6 | 11.9 | 11.2 |
| Primary metal industries[2] | do | (3) | (3) | NA |
| Stone, clay, and glass products[2] | do | .3 | .3 | NA |
| Chemicals and allied products[2] | do | .3 | .3 | NA |
| Petroleum and coal products[2] | do | .2 | .2 | NA |
| Construction | do | 16.8 | 20.8 | 20.1 |
| Transportation and public utilities | do | 18.4 | 18.6 | 18.9 |
| Wholesale and retail trade | do | 37.5 | 41.4 | 44.6 |
| Finance, insurance, real estate | do | 9.6 | 10.7 | 12.3 |
| Services | do | 37.0 | 39.8 | 43.2 |
| Government and government enterprises | do | 59.6 | 63.0 | 65.9 |
| Total | do | 200.4 | [4]214.3 | 225.0 |
| Personal income: | | | | |
| Total | millions | $7,517 | $8,358 | $8,739 |
| Per capita | | $16,912 | $17,364 | $17,487 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.6 | 36.2 | 39.3 |
| Mining | | 51.5 | 49.9 | 50.4 |
| Total average hourly earnings, production workers | | $11.74 | $12.33 | $12.25 |
| Mining | | $21.94 | $23.40 | $23.33 |

See footnotes at end of table.

Table 3.—Indicators of Alaska business activity —Continued

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Earnings by industry: | | | | |
| Farm income | millions | $4 | $5 | $6 |
| Nonfarm | do | $6,733 | $7,440 | $7,879 |
| Mining total | do | $493 | $489 | $542 |
| Metal mining | do | $19 | $23 | $19 |
| Nonmetallic minerals except fuels | do | $2 | $2 | $3 |
| Coal mining | do | $7 | $8 | $9 |
| Oil and gas extraction | do | $464 | $455 | $511 |
| Manufacturing total | do | $349 | $347 | $347 |
| Primary metal industries | do | (5) | $1 | $1 |
| Stone, clay, and glass products | do | $16 | $17 | $20 |
| Chemicals and allied products | do | $17 | W | W |
| Petroleum and coal products | do | $10 | $13 | $15 |
| Construction | do | $927 | $1,133 | $1,080 |
| Transportation and public utilities | do | $770 | $803 | $831 |
| Wholesale and retail trade | do | $808 | $926 | $1,015 |
| Finance, insurance, real estate | do | $246 | $302 | $355 |
| Services | do | $1,020 | $1,102 | $1,209 |
| Government and government enterprises | do | $2,080 | $2,280 | $2,435 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 8,290 | 11,272 | 6,481 |
| Value of nonresidential construction | millions | $313.4 | $357.2 | $405.9 |
| Value of State road contract awards | do | $111.8 | $123.0 | $156.0 |
| Shipments of portland cement to and within the State | thousand short tons | 171 | 180 | 197 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $112.9 | $124.5 | $88.7 |
| Value per capita | | $254 | $259 | $177 |

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Less than 50 employees.

[4] Data do not add to total shown because of independent rounding.

[5] Less than 1/2 unit.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

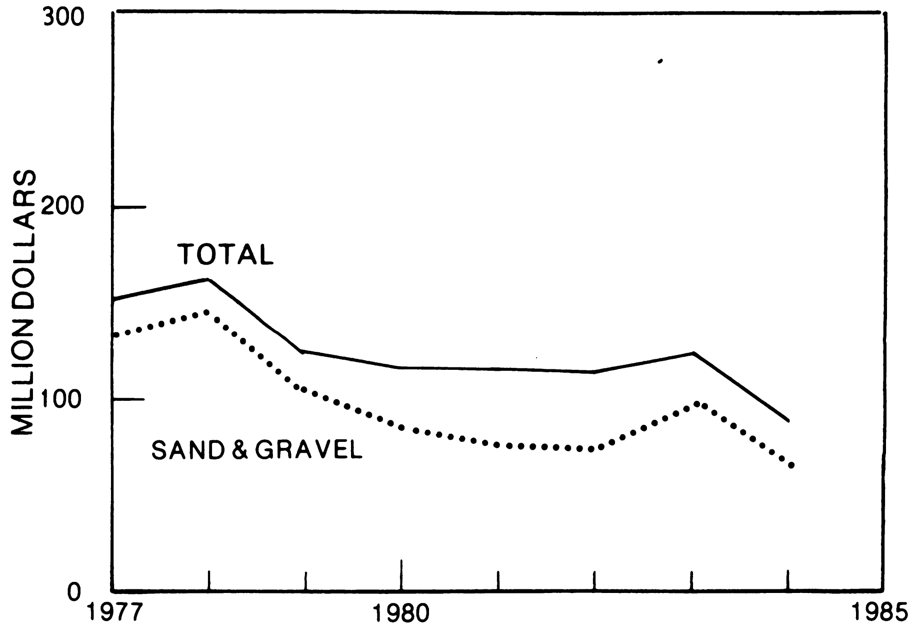

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Alaska.

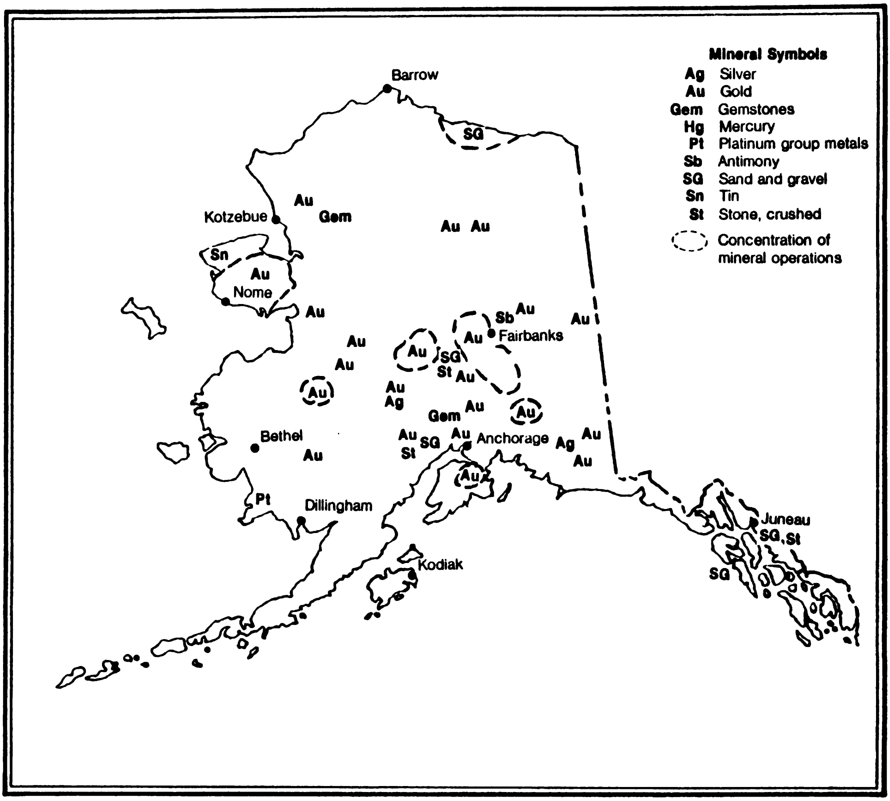

Figure 2.—Principal mineral producing localities in Alaska.

**Trends and Developments.**—There were about 8,400 new mining claims located and recorded in 1984. This compares with the revised data of 10,745 in 1983, 14,952 in 1982, and 27,397 in 1981. Exploration expenditures for nonfuel minerals were about $20.2 million, according to State surveys. Similar revised expenditures in 1983 and 1982 were $32.8 million and $42.7 million, respectively. Development outlays were $26.3 million in 1984, $27.6 million (revised) in 1983, and $33.8 million (revised) in 1982. Continued relatively low base and precious metals prices lowered exploration and development budgets of formerly more active companies. Tougher water quality and environmental standards and continued withdrawals of Federal and State lands from location for hard-rock and placer minerals have lowered mineral-related activities. Construction sand and gravel production was much lower in 1984 than in 1983 because fewer offshore islands were built for drill platforms for petroleum exploration, and there was a decline in new construction in the more populous areas of Alaska. State surveys show gold production was about 175,000 troy ounces, an increase over the 1983 production. Fewer mechanized placer operations produced more metal by increasing mining rates, getting better recoveries of fine gold, and some miners processed higher grade reserves. There is a trend toward more efficient and environmentally acceptable practices. These include better control of feed rates, washing, and rejection of coarse gravel ahead of sluices and other metal recovery units and better recovery of fine metal and concentrate. There is an increasing use of undercurrents, jigs, and spiral concentrators. More and better settling ponds, recycling of clarified circuit water, and some use of flocculants have improved the quality of mining discharges to streams. Claim owners are abandoning many low-grade base metals deposits that do not contain possible economic amounts of gold or silver or metals with relatively high unit values, such as tin or tungsten.

The Alaska State Division of Mining (DOM), Department of Natural Resources (DNR), has resumed processing the backlog of about 850 applications for offshore mining permits on State lands. No permits were processed from 1975 to 1984. No additional applications will be accepted until DOM reviews each area with current applications and determines that offshore mining is in the best interest of the State. It must also be consistent with the Alaska Coastal Management Program and the State's Tidelands Program. Areas of most interest are the Seward Peninsula (gold), Goodnews Bay (platinum-group metals), Cook Inlet (gold), Cape Yakataga (gold), and several areas in southeast Alaska for gold, barite, magnetite sands, and molybdenum. A Geologic Materials Center was established at Eagle River, north of Anchorage, as a joint venture by the Division of Geological and Geophysical Surveys (DGGS) and the U.S. Geological Survey. DGGS will operate the facility. It will house core and rock samples from Alaskan mineral exploration and other projects. Access to these samples and cores will be of great value to industry and governmental agencies in evaluating petroleum, coal, and other commodity and mineral resources of the State. A mineral education program, "Alaska Resources Kit: Minerals," has been developed for public school use in grades 4 through junior high school. The program was developed by the Alaska Department of Education, the Alaska Mineral and Energy Resources Educational Fund (AMEREF), and interested advisory groups. Funding was supported by AMEREF, Alaska Miners Association, industry groups, and private donations. A hydrometallurgical process to recover base and precious metals from complex sulfide ores is being evaluated by the Mineral Industry Research Laboratory at the University of Alaska. The research is funded by a grant of $144,000 by Nerco Minerals Co. An economic process for recovery of metals from sulfide and complex ores at or near minesites would be invaluable to Alaska.

Annual canvasses and surveys of Alaska mineral producers, developers, and explorers by the U.S. Bureau of Mines and DGGS provide detailed information on the mineral industry. Summarized results of the State surveys are presented in "Alaska's Mineral Industry 1984." This is the fourth annual report produced jointly by the Alaska Department of Commerce and Economic Development, Office of Mineral Development, and DNR's DGGS.

**Employment.**—The State estimates at least 2,325 people were employed in nonfuel mineral production activities in 1984. At least 550 people were seasonally employed in construction sand and gravel and crushed stone operations. About 1,700 people were employed between April and November in an estimated 280 large and small placer mines. This estimate does not include employment at nonproducing exploration and development projects. A similar survey in 1983 indicated at least 2,500 people were seasonally employed in nonfuel and coal mining. About 400 people were believed engaged in construction sand and gravel and crushed stone operations and at least 2,000 at placer mines.

**Exploration Activities.**—State surveys of contract drilling in 1984 list 305,000 feet of placer and hard-rock, nonfuel mineral drilling. Similar figures for 1983 and 1982 were 233,500 feet and 324,000 feet of contract drilling, respectively. In 1984, contractors reported 129,000 feet of placer drilling and 176,000 feet of hard-rock drilling. In addition to this placer drilling, there was an unknown footage of in-house drilling done by mine operators. Of the reported placer drilling, 31,000 feet was for exploration and 98,000 feet was at thaw fields ahead of dredging. Over 75% of the 176,000 feet of hard-rock drilling was for detailed exploration of precious metals deposits. Not included in the hard-rock footage was 4,300 feet of geotechnical drilling at the Red Dog project. This footage included foundation investigations for the road, dam, and mill facilities. The State listed 23 drilling contractors active in Alaska in 1984.

**Legislation and Government Programs.**—Five of the eighteen bills of interest to the mineral industry that were submitted to the 1984 legislative session became State laws. One bill appropriated $12 million for phase 1 of a new port facility at Nome. A bill authorized acquisition of the

Alaska Railroad by the State from the Federal Government. An act relating to mining on State lands provided amendments to State mining location and leasing laws, definition and recording requirements for annual work, provisions for prospecting permits, and other features. An act relating to land disposal and management established the basis for procedures for classifying land, making land available for private use, and minimizing the effects on the natural resources. A bill to set up a Mining Water Use Board passed the legislature. This bill also specified that the Commissioner of DNR shall administer the innovative gold recovery demonstration grant program and the placer mining water reduction loan program. Regulations related to the act affecting mining on State lands were published in November 1984. The Department of Environmental Conservation and DNR published a notice in November of intent to adopt regulations to implement the placer mining demonstration grants program. It is hoped grant-generated data will begin to aid miners late in the 1985 season and will benefit miners and regulatory agencies in the future by enhancing fine gold recovery, assisting in meeting effluent standards, and minimizing environmental damage.

The City and Borough of Juneau advertised for proposals to draft a comprehensive mining ordinance and a land use plan for municipal lands leased for hard-rock mining. Work on these ordinances was still in progress at the end of 1984. Miners are concerned that the ordinances will be too detailed to permit economic and practical implementing regulations. Several cities and boroughs in the State are interested in the final ordinances as possible models for their own use.

Access is a critical problem for many mineral sites because the present complex patterns of land ownership and use restrictions have developed since statehood. From 1866 to 1976, Federal law granted rights-of-way to States for trails and roads over unreserved public lands if the trail or road was used. These rights-of-way became known as RS 2477 trails after the law that granted them. Most of the major highways, roads, and trails in Alaska began as RS 2477 trails, but many of them had not been identified and recorded on U.S. Bureau of Land Management (BLM) land status maps. Without official designation, these RS 2477 rights-of-way continue to be valid but were not recorded, resulting in conflicts with some landowners and managers, and court cases are resulting.

The Alaska Department of Transportation and Public Facilities and DNR signed a Memorandum of Understanding with BLM providing that DNR will identify RS 2477 trails, make assertions to BLM, and BLM will then include the trails on its land status maps. Inadequate information on mineral resources is a serious defect in many State and Federal land use and management plans and in many environmental impact statements. National and State conservation units now contain about 170 million acres of land where mineral entry is banned or restricted. Many of the proposed land use plans will restrict or ban mineral entry and production. The Federal management plan proposed for the Steese National Conservation Area and the White Mountain National Recreation Area would close another 1 million acres to placer mining, including much of the Circle mining district, and will affect mines bordering the areas. Costs at existing mines will probably rise from 10% to 100%, according to the environmental impact statements.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Asbestos.**—The Alaska asbestos properties south of Eagle were reported to be idle. Some work on fiber yield and quality continued on samples previously supplied to the Ontario Research Foundation. The project is a joint venture of the Doyon Regional Corp. and GCO Minerals Co.

**Cement.**—Anchorage Sand and Gravel Co. produced finished portland cement from domestic clinker and gypsum at its grinding and blending plant in Anchorage. Part of the portland cement was used in the company's ready-mixed concrete, concrete block, and precast concrete operations, and some was sold to customers.

**Gem Stones.**—The value of gem stones reported in 1984 was $60,000, the same as in 1983. Soapstone was produced in the Salcha River and Talkeetna areas. The material suitable for carving is sold to shops and individuals, and it is worked up into art objects for commercial outlets and by hobbyists for personal uses and gifts. Most of the jade comes from Jade Mountain and the Shungnak area east of Kotzebue. NANA Regional Corp. recovers jade from Native land and transports it to Kotzebue for cutting, polishing, carving, and other processing at shops of its subsidiary, Jade Mountain Products Inc. Jade is also produced by Ivan Stewart from his claims near Shungnak. Most of this material is sold or processed through Stewart's shop and store in Anchorage. Brown coral is obtained from coastal waters and used in jewelry items. Clays and selected rock-flour materials are used locally for producing commercial and hobby pottery. Specimen epidote and other crystals were recovered by the owners from their patented claims on Green Monster Mountain, Prince of Wales Island. A world-class specimen was acquired by the University of Alaska Museum. It has a 5-inch crystal surrounded by several shorter ones and many small quartz prisms.

Two diamonds have been found in gold-placer sluice-box concentrates from Crooked Creek in the Circle mining district. Jim Regan found a small 0.3-carat diamond in 1982 that was not positively identified and publicized until recently. In 1984, a 1.4-carat diamond was recovered by Frank Warren. These discoveries have triggered some intensive local geological investigations, but no probable source of the diamonds has been discovered. Test work on recovery and identification of more diamonds and the relatively low-density minerals that usually accompany them is scheduled for the 1985 mining season.

**Sand and Gravel (Construction).**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel produced in 1984 was reported to be 30.9 million short tons valued at $66.9 million, a substantial decrease from the estimated quantity and value of production in 1983. Alaska ranked fifth in the United States in the amount of construction sand and gravel produced and ninth in value. There was no reported production of industrial sand and gravel. State surveys and interviews indicated sand and gravel production in the northern and western regions was about 12.6 million tons, over 40% of the State total. Most of this material was used in the North Slope Oilfields to construct drill-site islands, drill pads, pipeline supports, other infrastructure sites, causeways, and various other uses. Production in the Fairbanks area was from floodplain deposits near the Tanana River and from similar deposits and placer mine tailings in the Fox, Goldstream, and Ester areas. Gold was also recovered from at least two of these operations.

Most of the construction sand and gravel used in the Anchorage area was deposited by old glacial meltwater streams in the Palmer-Wasilla area. In 1984, about 6.5 million tons of sand and gravel was hauled to Anchorage by unit trains, compared with 4.4 million tons in 1983 and 2.8 million tons in 1982. During the heavy construction period, the railroad operated eight 80-car unit trains daily on the gravel haul. About 1 million tons of sand and gravel was hauled by trucks. Juneau and Ketchikan get almost all of their sand and gravel from streambeds or outwash pits. Sand and gravel production will probably decrease on the North Slope as construction and production drilling is brought to a steady state in the known oilfields and specially designed Arctic drill ships partially supplant gravel islands in offshore drillings. Declining oil revenue will reduce State construction funds available to urban areas, as will reduced Federal funding.

**Table 4.—Alaska: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 169 | $928 | $5.48 |
| Plaster and gunite sands | 7 | 55 | 8.00 |
| Asphaltic concrete | 375 | 1,717 | 4.57 |
| Road base and coverings | 418 | 1,670 | 3.99 |
| Fill | 1,611 | 5,351 | 3.32 |
| Snow and ice control | W | W | 4.49 |
| Railroad ballast | W | W | 4.00 |
| Other[1] | 28,278 | 57,161 | 2.02 |
| Total[2] or average | 30,861 | 66,883 | 2.17 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes other unspecified uses and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed and broken stone production in 1984 was estimated at 2.5 million short tons valued at $10.8 million, a substantial increase over 1983 production and value. No production of dimension stone was reported to the U.S. Bureau of Mines in 1983 or estimated in 1984.

Yutan Construction Co. produced an estimated 600,000 tons of basalt for use as riprap, road surfacing, crushed fill material, and ornamental stone. Sunrise Exploration Services mined high-quality stone from its quarry near the Hope Road, off of the Seward Highway. The City of Valdez used granitic rock quarried 6 miles east of the city to construct a seawall at the Port of Valdez. Ketchikan Ready-Mix and Quarry Inc. mined 45,000 tons of basalt for shot rock, about the same amount mined in 1983.

Some agricultural limestone was mined on the Kenai Peninsula. No reports were received on similar proposed mines north of Anchorage. A Fairbanks group is endeavoring to build a market for decorative marble and has furnished some stone to local customers. The owners say tests show the marble exceeds strength requirements for uses in buildings. Minimum required work was performed at the View Cove claims on Dall Island, southeast Alaska. These claims are on cement and metallurgical-grade limestone. Two private groups have been scouting for marble deposits in southeast Alaska that will produce material suitable for building facings, slabs, and other decorative products.

## METALS

**Antimony.**—Several small lots of high-grade antimony ore were shipped from Alaska in 1984. Most of these lots were hand-sorted stibnite (antimony sulfide) recovered by individual miners from vein deposits in the Fairbanks and Circle mining districts. The ore is usually sold on a spot market to individual buyers that represent chemical or battery manufacturers. Market prices and demand have been unpredictable in the last few years. Often during long periods of low prices and demand, owners of deposits will build up small lots of sorted ore at their minesites as they do annual work on their claims. When buyers appear, there is usually a limited amount of suitable ore available, but there is seldom a demand that triggers sustained mining projects. State surveys recorded about 135,000 pounds of antimony produced in 1984; a significant increase was reported at the Sawtooth deposit, west of Livengood, by HCA International of Sarasota, FL.

**Copper and Lead.**—No production of copper or lead ores was reported in 1984. Kennecott Corp. continued assessment work and limited exploration on its various claim groups in the copper-zinc-silver belt north of the Kobuk River and about 120 to 200 miles east of Kotzebue. The work included geologic mapping, geochemical sampling, geophysical surveys, and diamond drilling. The Arctic deposit, near Ambler, has reported drill-indicated reserves of over 35 million tons averaging 4.0% copper, 5.5% zinc, 0.8% lead, 1.6 troy ounces of silver per ton, and 0.02 ounce of gold per ton. The Bornite deposit, north of Kobuk, reportedly contains reserves of about 40 million tons averaging about 2% copper, with some zinc and possibly interesting amounts of cobalt. About 5 million tons range from 4% to 12% copper. Kennecott maintained several other groups of claims situated from west of Arctic easterly to Picnic Creek. It also worked on the Husky Group, west of Ambler, held in a joint venture with NANA Development Corp. The Smucker, Tom Tom, and other claim groups held jointly, and separately, by Anaconda Minerals Co. and Sunshine Mining Co. received required assessment work. Noranda Exploration Inc. and GCO Minerals did assessment work on their claims in the Ambler District.

The Zackley and Zackley Extension copper-gold-silver skarn deposits, in the Mount Hayes Quadrangle, were sampled and mapped by a joint venture consisting of Nerco Minerals Co./Resource Associates of Alaska Inc. (Nerco/RAA) and Teton Exploration Drilling Inc. A geophysical survey was run on massive sulfide deposits in the Alaska Range about 50 miles south of Fairbanks. These copper-lead-zinc-silver deposits were being explored by Nerco/RAA with Getty Oil Co. Others exploring similar deposits in this area were Amax Exploration Inc. and Northern Lights Exploration Co. Copper claims in the Wrangell Mountains, east of McCarthy, were maintained by Geneva Pacific Corp. and by the Van Zelst Group. In 1983, Geneva Pacific concluded exploration on about 500 claims and donated its rights on them to the National Park Service. Favorable exploration results by Falconbridge Ltd. and Geddes Resources

Ltd. at the Windy Craggy copper-zinc-cobalt-gold deposit in British Columbia, Canada, west-northwest of Haines, has caused renewed interest in the area along the Canadian border from south of Glacier Creek to north of Mount Henry Clay. Discovery of large, high-grade copper-zinc float boulders below the face of a small remnant glacier on the eastern face of Mount Henry Clay caused intensive prospecting and claim staking. A partnership group did detailed geologic mapping, geophysical surveys, and about 2,000 feet of diamond drilling searching for the bedrock source of the boulders, some of which are more than 6 feet in diameter. The partnership group consisted of Kennecott (operator), Southeastern Minerals Co., Marmot Mining Exploration Corp., Alyu Mining Corp., and Hawley Resource Group. This prospect is named "Boulderado."

Kennecott and Hawley explored for copper-lead-zinc-gold-silver ores in the Duncan Canal-Zarembo Island area west of Wrangell. Drilling and other exploratory work was done on the Frenchy Prospect, southeast of St. Johns Harbor, Zarembo Island. Exploratory diamond drilling covered the assessment work on the nickel-copper claims at Mirror Harbor, Chichagof Island, and the unpatented claims at Bohemia Basin, Yakobi Island. Galactic Resources Ltd. controls these properties. The Sumdum Chief copper property at Holkham Bay, south of Juneau, and the Denali copper property, north of Susitna Lodge, were kept active by their current owners. Orbex Minerals Ltd. did some exploratory work at the Salt Chuck Mine. This former copper-gold-palladium-platinum producer is at the head of Kasaan Bay, Prince of Wales Island. Noranda Exploration, Houston Oil and Minerals Co., and Lac Minerals Ltd. explored copper and precious metals claim groups near Niblack, Anchorage, and the South Arm of Cholmondeley Sound on Prince of Wales Island and precious and base metals claims near McLeod Bay, near the southern end of Dall Island. Exxon Minerals Inc. completed exploration of its two claim groups east-southeast of Twelvemile Arm, Prince of Wales Island, and examined copper prospects near Trocadero Bay.

Anaconda explored its copper-gold-silver claims in the Illinois Creek area of the Kaiyu Mountains, about 40 miles south-southwest of Galena. State information indicates a 50-person crew conducted mapping, trenching, geophysical and geochemical surveys, and completed over 21,000 feet of drilling.

Claims on Bering Straits Native Corp. land near Mount Diston were explored by Kennecott. Greatland Exploration Ltd. worked on its lead-zinc-silver claims in the Darby Mountains near the old Omalik lead-zinc-silver mine, about 35 miles north of Golovin, also on the Seward Peninsula. Nerco/RAA further explored its extensive holdings in the "Delta schist belt," south of Tok. The area contains at least 35 known stratiform deposits with lead-copper-zinc-silver-gold values and several replacement massive sulfide deposits. The operator is concentrating on zones with the highest precious metals values while maintaining about 2,300 State mining claims. In the Bonnifield District to the west, Cominco Alaska Inc. explored the Liberty Bell Mine area; Amax Exploration looked for massive sulfide ores; and Northern Lights Exploration conducted exploratory activities as assessment work on 814 claims. Hunt Oil Co., Minerals Div., continued work on its claim groups in the eastern part of Lime Hills, south of McGrath, in the Big River area. Various areas contain lead, silver, zinc, gold, molybdenum, tin, and tungsten minerals.

**Gold.**—Gold production reported to the U.S. Bureau of Mines in 1984 was 23,232 troy ounces valued at about $8.4 million. This is probably about 13% to 15% of the actual Alaskan production. The best available estimate is at least 175,000 ounces of gold produced in 1984, calculated by the State. In "Alaska's Mineral Industry 1984," sources of information used to estimate placer gold production included (1) conversations with 15 consultants familiar with mining activities statewide, (2) DGGS questionnaires that include production data from 48 mechanized placer mines, (3) information from DGGS and DOM personnel working in placer mining regions where they obtained data from about 40 operations in 4 of the 7 regions outlined in the report, (4) company news releases and annual reports to stockholders, and (5) estimates of total gold bullion received by several refiners of Alaskan placer gold.

State surveys indicate about 250 mechanized placer mines and 25 to 30 recreational operations produced at least 175,000 ounces of gold and about 20,000 ounces of silver. Similar State surveys in 1983 listed production of about 169,000 ounces of gold and 18,000 ounces of silver by about 296 mechanized placer mines and 40 recreational placer mines. In 1983, the average price realized was $400 per ounce for gold and about $10 per ounce for silver; in 1984, the respective prices were $360 and about $8. Many operators that were marginally economic in 1983 did not mine in 1984. There was no reported gold or silver production from lode mines in 1984.

At least 20 placer miners recovered 15,000 ounces of gold and 1,500 ounces of silver in the Northern region in 1984, about double the production in 1983. Water was plentiful, and better grade reserves had been developed. The Northern region is that part of Alaska north of latitude 67 degrees north. Timber Creek Mining developed reserves and produced gold at Weise and Timber Creeks, about 70 miles northeast of Kotzebue and 10 miles north of Klery Creek. Other producing creeks, near the Trans-Alaska Pipeline corridor, were Archibald, Emma, Linda, Nolan, and Vermont in the Coldfoot area, and Davis and Grubstake Creeks near Bettles. Canadian Barranca Corp. Ltd. mined and developed placer claims leased from Little Squaw Gold Mining Co. in the Chandalar area, about 180 miles north of Fairbanks. Among other companies reported doing some work in this region were Silverado Mines Ltd., Burke Mining Enterprises of Fairbanks, and Alminco of Anchorage.

In the Western region, the State estimates about 30 placer mines produced an estimated 36,000 ounces of gold and 5,500 ounces of silver. Alaska Gold Co. was the largest producer in the region. Its No. 5 and No. 6 bucket-line dredges near Nome operated from May 29 to October 24 and to November 12, respectively. Its Hogatza dredge, west of Hughes, was idle. Alaska Gold employed about 110 people at Nome on dredge operation and thaw-field preparation and 14 people on exploration, development, and other activities at Hogatza. Small bucket-line dredges were operated on the Seward Peninsula by the Engstrom, Peterson, and Tweet families. These dredges range from 1-1/2 to 2-1/2 cubic feet per bucket. Pat Bliss has a similar dredge on the Ungalik River near the eastern end of Norton Bay. AU Mining Inc. mined leased ground near Candle. Hugo Linfors and C. M. Reader produced gold at Iron Creek, a tributary to the Pilgrim River, on the Seward Peninsula.

Yukon Mining Co. developed its property and produced gold about 60 miles southwesterly from Galena, in the Illinois Creek area of the Kaiyuh Mountains. Degan Mining Co. operated a placer mine on Madison Creek in the Tolstoi District. While developing a deep underground placer on Boob Creek, near Tolstoi, a group headed by Douglas Sherrer of McGrath produced some gold from shafts and drifts. The Ruby District produced from a placer on Swift Creek. Conrad House, the operator, spent part of the season preparing settling ponds and repairing equipment. Rosander Mining Co. continued mining at Colorado Creek, about 60 miles north-northwest of McGrath.

Power Reseurces Corp. (Powerco), of Lakewood, CO, agreed to purchase six mining leases covering 21,750 acres offshore of Nome from ASARCO Incorporated. This area was drilled and evaluated several years ago by Asarco and Shell Oil Co. Powerco is proceeding with permit applications and financing. The announced plan is to start mining in 1985 at a rate of 8,500 cubic yards of seabed material per day, using a bucket-line dredge. The lease blocks cover an area from about 1 mile east to about 11 miles west of Nome. The company plans to mine between 250 feet and 1 mile offshore. The dredge would dig to approximately 5.5 feet into the seabed and discharge tailings back into the dredged cut. Another offshore exploration project was run in Norton Sound by Greatland and Coastal Exploration of Kasilof. They reported using a 12-inch suction dredge to test and evaluate their prospect. Rhinehart Berg, Thor Wetlesen, and J. Bullock trenched placer ground on Short Creek, in the Kugruk Valley, and on Jump Creek near Candle. The Kelly Creek lode gold prospect on the American River was the site of some diamond drilling and soil sampling by Anaconda. Assessment work was done on the Big Hurrah Mine property of Cornwall Pacific Resources Ltd. at Big Hurrah by the Hawley Resource Group. This old gold-tungsten mine is north of Solomon and east of Nome.

The Eastern Interior region produced an estimated 70,500 ounces of gold and 10,000 ounces of silver, according to State surveys. This is about 40% of Alaska's 1984 production and is credited to 140 mechanized operators. Gold output in 1984 was about 16% below 1983 output. Because of lower gold prices, depletion of reserves, environmental problems, and other causes, 14 of the 1983 operators were not active in 1984. This region extends from about 20 miles west of Tanana east to the Canadian boundary and from the latitude of Paxson to about 30 miles north of Fort Yukon. The most productive placer area in the State, again, was the Circle mining district. It accounted for about one-half of this region's gold in 1984. GHD Resources, Gold Dust Mines, Greenhorn Mining, and most of the other more productive operators are improving their recovery of fine gold by various methods, including attention to gravel and water feed rates, washing and rejection of coarse waste, better sluice box design, and the use of improved models of jigs and spirals. Many of the creek deposits are becoming depleted, and several operators have exploration and development projects active to find and to extend reserves. The rather extensive bench gravels are receiving considerable evaluation effort.

The Fortymile District has maintained a fairly uniform production for several years. State surveys list some of the principal producers, which include Albett Mining and Aurum Philosophorum Inc. on Chicken Creek and Kavic Mining Inc. and Royann Mining on Jack Wade Creek. Tertiary and other bench gravels are being searched for mineral reserves. The Manley and Rampart areas were more productive than in 1983. Hoosier Mining Co. on Hoosier Creek and Thanksgiving Mining Co. on Slate and Thanksgiving Creeks were among the active operators. The Fairbanks mining district had at least 14 operators, 4 less than in 1983. Some of the larger operations were Earthmover Inc. near Ester; Eveco Inc. near Fox, producing gold with construction sand and gravel; and Last Chance Mining Co. on Fish Creek, a tributary of Fairbanks Creek. High Bench Placers resumed production this year in the Richardson area, near Delta.

The Bonnifield District had placer operations on California, Daniels, Eva, Grubstake, Iron, Long, and Moose Creeks. Placer production has been quite steady for several years. The Kantishna mining district had at least 17 operators and yielded about 7,500 ounces of gold in 1984, about the same as the 1983 production. State surveys show active placers on Caribou, Eureka, Glacier, Glenn, Rainy, and Spruce Creeks. A 91-ounce nugget was recovered, believed to be the fifth largest nugget discovered in the State. There was also a 28-ounce nugget recovered.

Chena Mining Co. was developing its claims on East Fork of the Chena River. Greatland drilled a deep placer on Little Eldorado Creek, off of Goldstream Creek. Silverado has been prospecting and exploring a large block of claims on Ester Dome, about 10 miles west of Fairbanks, for several years. To date, the most interesting property is the old Grant Mine. Silverado acquired the Grant Mine from Roger Burggraf, who had cleaned out the old workings, did additional sinking, and discovered the O'Dea vein, a more promising structure than the known Irishman vein. Silverado conducted a rewarding exploration and development program on its holdings, and has a joint venture to further develop the Grant Mine property and put it in production in late 1985. The venturers are Silverado, Aurex Inc., and Tri-Con Mining Inc. Aurex is controlled by Marubeni America Corp. The 1985 $1.9 million development program was reported to indicate adequate reserves for a 200-short-ton mill. They are considering starting with a nominal 100-ton unit in 1985. The Ryan Lode property, on Ester Dome west of the Grant Mine, is held by St. Joe American Corp. Assessment work in 1984 consisted of sonic drilling.

Placid Oil Co. has been exploring several prospects and old mines in the Cleary area about 20 miles west of Fairbanks. The company is reported to have acquired a large block of claims that include the Kavilita, Cleary, and Hi Yu veins and lodes. These deposits have been explored by Placid, using drilling and underground workings to help evaluate them. In 1984, Placid reported geologic mapping and sampling, surface drilling, and trenching on the properties. Mohawk Resources Alaska Inc. continued exploration in the Fairbanks area. The company did exploration and assessment work consisting of drilling, geologic mapping, geophysical surveys, and geochemical surveys. Mohawk has a small but versatile custom mill at Fox, about 10 miles north of Fairbanks. Exploration was continued at the Clipper Mine, Ester Dome, by the Lounsbury brothers and Robert Grieg. Hecla Mining Co. withdrew from an exploration venture with Nerco/RAA in the Fairbanks District after merging with Ranchers Exploration and Development Corp. There were apparently some favorable results obtained within the 14,000 acres controlled by Nerco/RAA during the quest for gold, tungsten, and other metals.

In the Southwest region, 24 placer mines produced about 16,000 ounces of gold, a slight increase over 1983 production, according to State surveys. Among the more successfull operations were Lyman's Mine on Snow Gulch in the Crooked Creek area, the Magnuson Mine on Ganes Creek, and the Misko-Walsh Mine on Otter Creek, near Flat. Flat Creek Placers developed reserves on Chicken and Flat Creeks and on the Willow Bench, near Flat. Alaska Construction and Mining temporarily stopped work at Moore Creek and started stripping on Deadwood Creek. Richard and Larry Wilmarth continued to mine on Julian Creek, a George River tributary, and L. E. Wyrick started a mine on Granite Creek, near the headwaters of the George River. Northland Dredging Co. was still unable to operate its newly rebuilt 6-cubic-foot dredge on the Tuluksak River because of permitting problems and legal actions by the village of Tuluksak. The activities of Tuluksak Dredging Ltd., also in the Nyac area and upstream from Northland, are unknown. It had been operating a smaller bucket-line dredge and a stream placer.

Miskovich and Walsh Mining Co. did assessment work on the Golden Horn gold-tungsten property near Flat and had some gold-tungsten sluice concentrates to market. The concentrate was recovered from placer and lode material from the shear zone. Cominco Alaska explored in the Nushagak River area for precious and base metals. The company used diamond drilling, geologic mapping, and geophysical surveys. JMF and Associates of Bethel explored a claim group in the Goodnews Bay Quadrangle. Julian Creek Mining Co. of Red Devil prospected several placers by sinking test pits. Forty Seven Creek Mines tested placer and lode claims 40 to 50 miles south of McGrath. It prospected a large low-grade placer by dozer trenching and putting the excavated material through a washing plant. The operation was apparently terminated late in the season and the equipment moved to Sleetmute.

There was no reported significant placer production in the Alaska Peninsula and Kodiak region. Alaska Apollo Gold Mines Ltd. did some work on its Shumagin claim group on Unga Island. The work consisted of building roads and preparing drill sites. Nerco/RAA's gold claims on Unga Island were inactive. Anaconda used diamond drilling, rock geochemisty, and geophysics to help evaluate the Pat Group gold-silver-lead-zinc-copper claims west of Chignik on the Alaska Peninsula.

At least 20 placer operations produced 37,500 ounces of gold and 4,500 ounces of silver in the South Central region. This region extends from 153 degrees west longitude, just west of Cook Inlet, east to the Canadian boundary, including the Yakutat Quadrangle, and from the 63d parallel south to the Gulf of Alaska. The outstanding development in this region was the Valdez Creek joint venture, headed by Camindex Mines Inc., delineating adequate reserves and bringing its property into production. The property is just north of the Denali Highway, at Denali, between Paxson and Cantwell. Company news releases stated it had 513,000 cubic yards of reserves containing about 61,500 ounces of gold. In 1984, an estimated 19,859 ounces of placer gold, averaging 852 fine was recovered, according to the State survey. The company discovered three shallow high-grade channels as well as four other bedrock depressions with a potential for gold concentrations. The washing plant uses a standard sluice with Hungarian riffles. The sluice is 40 feet long and 5 feet wide. The designed capacity of the washing plant was 2,500 cubic yards per day, but it only operated well at about 1,700 cubic yards per day. To meet the planned operating rate, a second 1,500-cubic-yard-per-day washing plant was purchased and became operational in September. The State believes this mine is the largest single gold producer in Alaska in 25 years. SUM Resources Inc. of Toronto is the operator.

Important placer producers included Nelchina Mines Inc. on Yako Creek in the Nelchina mining district; Fortune Mining Co. near Hatcher Pass; J and S Mining Co. and K and K Mining Co. in the Cache Creek area; and Jones and Co. near Sexton in the Hope mining district. No reports were received on the formerly productive operation of Talmo Inc. in the Wrangell Mountains.

The Golden Eagle Mine of Territorial Corp. and other placers in the Chistochina District were productive. There were active placers on Willow Creek and a considerable number of recreational and other small placers on the Kenai Peninsula. Gold Cord Development Corp. did some underground exploration and development work at its mine near Hatcher Pass. The Independence Mine, also near Hatcher Pass, was not operated by Enserch Exploration Inc. Aspen Exploration Corp. continued some exploratory activities on its Cook Inlet offshore prospecting sites. State survey data show it spent about $400,000 in 1984 on exploration that included geologic mapping, extensive beach sampling, and 6,400 line miles of low-level aeromagnetic surveys. Aspen Exploration's applications to lease over 1 million acres for offshore dredging have not been approved by DNR because of continued stiff opposition by environmental groups, fishermen, and other people.

Alaska Gold Mines Ltd. continued a bulk sampling program on beach sands along the Gulf of Alaska shore in the vicinity of Cape Yakataga. Cusac Industries Ltd. is also interested in this venture. It reported digging trenches 10 feet deep and 50 feet long and processing the excavated material in a portable washing plant to recover gold and other minerals and evaluate the economic potential of its claims.

Noranda Exploration leased and explored a large block of beach claims between Icy Bay and White River, east of Cape Yakataga. North Coast Mining Co. has held these claims and has been investigating them for gold and heavy mineral potential for several years. Noranda Exploration mapped and drill sampled the area. In addition to its own on-site recovery work, the company had additional beneficiation studies done by the University of Alaska.

Anaconda continued drilling and other exploration activities at the Johnson River and Difficult Creek gold-copper-lead-zinc-silver deposits. These deposits are about 12 miles west of Cook Inlet up the Johnson River Valley and about 10 miles southwest of Tuxedni Bay. The land is owned by the Cook Inlet Regional Corp., a joint venturer in the operation. The only available news release on exploration results was in early spring, so it summarizes 1983 data. Fourteen holes had been drilled. One hole had a deep intersection of 30 feet containing 1.2 ounces of gold per ton, 24.8% zinc, 2.8% lead, and 1.7% copper. An intersection in another hole assayed 0.6 ounce of gold per ton, 9.4% zinc, 2.8% lead, and 1.7% copper over an unstated width. Trenching at Difficult Creek, about 6 miles northeast of the Johnson Prospect, yielded assays of 0.3 ounce of gold, 2.3 ounces of silver per ton, and 15.4% lead. Two more seasons of drilling with two drill rigs are planned on the basis of these results.

The Southeastern region and the Alaska Peninsula were credited with only two mechanized placer operations and a production of about 100 ounces of gold in 1984 by State surveys. No production of placer or lode gold was reported to the U.S. Bureau of Mines.

John Schnabel started up his mechanized placer mine near the mouth of Porcupine Creek, west of Haines, but suspended mining because of litigation on claim ownership. There will be no significant activity on the creek this year because of this court action and other similar cases. There was a small amount of placer recovered by a few suction dredge operators in the Haines and Juneau areas. Juneau Mining Co. did not operate its tailings retreatment plant at Thane, south of Juneau, because of mechanical and financial problems. Barrick Petroleum Corp., Alaska Inc. (BPC) signed a lease on the Alaska Juneau Mine and the Treadwell Group of properties in March 1984. Negotiations with the City and Borough of Juneau and Alaska Electric Light and Power Co., owners of the properties, started in 1983. BPC will investigate the possibility of establishing large-scale, low-grade gold and silver mines near Juneau. WGM Inc., consultants for BPC, studied the old mine maps and records, mine and mill production reports, and other available information; made a preliminary assessment of ore reserves, exploration targets, and status of property titles; and completed other preliminary work. The president of Barrick Resources Corp. told the property owners BPC has completed phase 1 of the 3-phase lease and would start phase 2 with drilling and sampling. WGM obtained a lease and option on the old Apex-El Nido Mines and other nearby claim groups northeast of Pelican and completed a preliminary examination of them late in the 1984 field season. BPC is a subsidiary of Barrick Resources, which is based in Toronto, Canada.

Placid continued exploration of the Kensington Mine and some contiguous properties at the head of Sherman Creek, about 40 miles northeast of Juneau. In a 108-day field season, Placid drilled 5,400 feet in 15 surface holes and did rock and geochemical sampling, according to the State survey. Kennecott completed the drilling and exploration program at the Jualin gold mine started in 1983. About 40 miles north of Sitka, exploration continued at the Chichagoff Mine, on the west coast of Chichagof Island. Queenstake Resources (USA) Inc. and Exploration Ventures Co. (Exvenco) are reportedly joint venturers in the project. Drilling and underground work are in progress to add to the ore reserves, test for extensions of previously mined veins, and to define new targets. The venturers announced they believe the project will reach the feasibility stage in 1985. Preliminary planning envisions a 300-ton mill to process about 100 tons of mined ore per day and 200 tons of old mill tailings per day. There are 465,000 tons of tailings that average 0.11 ounce of gold per ton. Mined ore is expected to average 0.5 ounce of gold per ton. Queenstake Resources is a major placer operator from the Dawson area in Yukon Territory, and is earning an interest in the Chichagoff Mine from Exvenco, the owner.

Pulsar Energy and Resources Inc. of Vancouver, British Columbia, Canada, has been investigating the gold potential of the Mineral Basin Mining Co. property north of Hyder. Pulsar was joined on this project in 1984 by Cube Resources Ltd. of Englewood, CO. Cube plans to explore and develop this 3,500-acre property for 2 years and then bring it to production or reassess its position. The property is currently known as the Alaska Star.

Table 5.—Alaska: Reported placer production of gold

| Year | Mines preducing | Material[1] treated (thousand cubic yards) | Gold recovered: Troy ounces | Gold recovered: Value (thousands) | Gold recovered: Average value per cubic yard |
|---|---|---|---|---|---|
| 1980 | 21 | 973 | 11,386 | $6,975 | $7.169 |
| 1981 | 21 | 3,257 | 26,432 | 12,149 | 3.730 |
| 1982 | 20 | 3,264 | 30,181 | 11,345 | 3.476 |
| 1983[r] | 20 | 3,194 | 39,470 | 16,735 | 5.240 |
| 1984 | 15 | 2,626 | 23,232 | 8,379 | 3.191 |

[r] Revised.

[1] Excludes material treated primarily for the recovery of platinum.

**Iron and Steel.**—There was no reported production of ferrous metals or slag. Unknown amounts of iron and steel scrap were shipped out as backhaul cargo. Two businesses are starting up that should help alleviate Alaska's ferrous scrap problem. K & K Recycling Inc., a new operation in Fairbanks, is cleaning and shipping waste ferrous metals from the North Slope and the Fairbanks areas. K & K recently worked 3,500 short tons of scrap from Fort Wainwright. ABC Auto Recycling will be operating in Anchorage by the spring of 1985. It is putting in a shredding and baling mill to handle more than 15,000 tons of ferrous metals per year.

**Molybdenum.**—The Quartz Hill deposit of U.S. Borax and Chemical Corp. has been explored and evaluated to a stage where it will be held practically on a care and maintenance basis until molybdenum prices and demand justify bringing the mine to production. The company estimates there are more than 1.5 billion short tons of minable ore averaging 0.14% molybdenite. This includes 200 million tons of readily accessible surface ore grading about 0.2% molybdenite. Major problems the company must solve before final production decisions include a decision on the site for tailings disposal, the location and design of a source of water for the mill, final permits, and decisions on generating diesel-electric power on the project or obtaining most of it from a tie to available power purchased from British Columbia Hydro and Power Authority. Among the local problems are decisions on mitigation of socioeconomic effects on Ketchikan and various environmental aspects.

**Platinum-Group Metals.**—No production of these metals was reported to the U.S. Bureau of Mines. The State reports the owners of the Goodnews Bay Mine are Hanson Properties Inc. of Spokane, WA, and Simplot Minerals of Boise, ID. In 1984, there was a limited exploration project to add to reserves for the idle bucket-line dredge. They used a drill, backhoe, and dragline to sample for platinum and gold.

**Silver.**—The quantity and value of silver production in Alaska in 1984 reported to the U.S. Bureau of Mines was withheld from publication to protect confidentiality of company data. State surveys report 1984 production at about 20,000 troy ounces of silver valued at $159,000. This was a sharp reduction from the State-reported 33,200 ounces produced in 1983 valued at $332,000. In 1984, all of the silver production was recovered with placer gold. The average price of silver was below $8 per ounce. In 1983, at an average of $10 per ounce, there was some production and shipment of silver ore.

Intensive exploration and development drilling continued at the Greens Creek deposit on Admiralty Island, about 18 miles southwest of Juneau. The deposit is in a nonwilderness part of the Admiralty Island National Monument. The U.S. Forest Service had validated eight core claims. The Alaska National Interest Lands Conservation Act (ANILCA) provided a period of 5 years within which a claim owner could explore within a radius of three-quarters of a mile of the core claims and obtain information that would justify validation of extensions or other deposits. That time limit expires December 2, 1985. In 1984, Noranda Mining Inc., operator of the Greens Creek joint venture, extended the 4,200-foot hanging-wall drift over 800 feet parallel to structure to provide more underground drill stations. About 21,500 feet of underground and surface diamond drilling was completed. Apparently, valuable additions to tonnage, grade, and lateral and depth extensions have been accomplished. In 1983, Noranda Mining proposed to the Forest Service that a portion of the Greens Creek watershed containing 17,225 acres be excluded from the monument and that the 18,174-acre Young Lake area be incorporated in the monument. This land trade would remove the claimed area and its partially explored deposits from the ANILCA time limit and allow orderly exploration after road access was established and as development and mining proceeded. A decision on the proposal by Forest Service officials in Washington, DC, was pending at the end of 1984. Engineering, metallurgical, and cost studies have resulted in some announced changes in proposed mining method, milling circuits, and mill size. Mining will probably be by open-stope methods instead of cut and fill, and the initial milling rate will be about 300 short tons per day, increasing to 600 tons per day as conditions warrant. Reserve figures listed in a paper presented by a company geologist at Anchorage in November 1984 stated that by the end of 1984, over 85,000 feet of core drilling from about 170 surface and subsurface stations established reserves of 3.5 to 4.0 million tons averaging 10.3 ounces of silver and 0.09 ounce of gold per ton, 6.4% zinc, and 2.1% lead. A high-grade ore reserve of about 1.5 million tons of 17.5 ounces of silver and 0.11 ounce of gold per ton, 9.7% zinc, and 3.4% lead exists within the ore body.

Anaconda explored the Pat Group of silver-gold-copper-lead-zinc claims west of Chignick Bay on the Alaska Peninsula. The company did detailed geologic mapping, geophysics, and rock geochemistry. The State reported some diamond drilling was done. The Hart silver lode claims at Cleary Hill, north of Fairbanks, was trenched by Alaska Mineral Services. Nerco/RAA did assessment work on a large group of claims in the vicinity of Hawk Inlet, Admiralty Island. This exploration was primarily a search for deposits similar to the Greens Creek ore bodies.

**Tin.**—Lost River Mining increased production of tin in cassiterite concentrate above the 1983 output at its Cape Creek placer mine on the western end of the Seward Peninsula. According to the State report, 35 to 40 feet of overburden must be stripped to recover a 3- to 6-foot tin-bearing pay streak on bedrock. No other tin production was reported to the U.S. Bureau of Mines or the State in 1984. Anaconda temporarily suspended exploration on its Kougarok Mountain tin-tantalum prospect on the Seward Peninsula. The company did some soil sampling and diamond drilling on the Storm Group of tin-silver claims about 40 miles northwest of McGrath in the Ophir Quadrangle. A lode tin prospect was located on the Seward Peninsula by M. T. Killion.

**Zinc.**—The Red Dog project of Cominco Alaska and NANA Regional, about 90 miles north of Kotzebue, is the most important zinc development in Alaska and probably in the Western World. Drill-indicated reserves in the main deposit are reported to be 85 million metric tons averaging 17.1% zinc, 5.0% lead, and 2.4 troy ounces of silver per ton. Cominco Alaska, the operator, did additional large-hole core drilling in the main deposit; more work on the nearby Hilltop deposit; foundation and road site drilling and evaluations; and initial designs for the minesite, tailings dam, mill, and other facilities. A geotechnical report on the proposed road was prepared from engineering, drilling, and other route studies. Cominco Alaska announced award of a contract to Dames and Moore for detailed site investigations and design of the tailings and water dams.

Cominco Alaska pursued negotiations to obtain aid from the State of Alaska in the form of interest-bearing loans to finance a road from the mine about 55 miles to a site on the Chukchi Sea coast and for the construction of a port facility. Cominco Alaska is working with the Alaska Department of Commerce and Economic Development to formulate a financing plan through the Alaska Industrial Development Authority for the road and port facility, estimated to cost about $160 million. Cominco Alaska will finance the other project costs, estimated at about $340 million. Enabling and appropriations bills will be introduced in the 1985 session of the State legislature. The initial planned operating rate will be 1.5 million tons of ore per year, with an increase to 2 million tons per year. NANA Regional is working on a suggested land exchange with the U.S. Department of the Interior to obtain approval of a road corridor through the Cape Krusenstern National Monument. Although the Red Dog project is on NANA Regional's land, it is within the North Slope Borough. NANA Regional is working toward establishment of a Kotzebue-based borough that would annex land containing the Red Dog to provide a tax base.

GCO Minerals announced it discovered what may be an important northern extension of the LIK deposit. LIK is along the Wulik River, about 12 miles west of the Red Dog. Preliminary estimates of drill-indicated reserves in the southern part of the LIK deposit are 24 million tons averaging 9% zinc, 3.1% lead, and 1.4 ounces of silver. GCO Minerals is said to have more than 7,000 claims it is exploring in the DeLong Mountains. Northgate Exploration Ltd. and Doyon Limited continued exploration of the Step Mountain zinc-lead deposit in the vicinity of Eagle, near the Canadian border.

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[1] State Mineral Officer, Bureau of Mines, Juneau, AK.

**Table 6.—Principal producers**

| Commodity and company | Address | Type of activity | Region |
|---|---|---|---|
| Cement: | | | |
| Anchorage Sand and Gravel Co | 1813 East First Ave.<br>Anchorage, AK 99501 | Grind and blend. | Cook Inlet-Susitna. |
| Gold: | | | |
| Alaska Gold Co. | Box 64<br>Nome, AK 99762 | Placer-dredge | Seward Peninsula. |
| Camindex Resources Inc | 330 Bay St., Suite 1120<br>Toronto, Ontario M5H 2S8, Canada | Placer | Yukon River. |
| Gold Dust Mines | Box 2141<br>Fairbanks, AK 99707 | do | Do. |
| McIntosh Co | Star Route 2, Box 22139<br>Fairbanks, AK 99701 | do | Do. |
| Nelchina Mines Inc | 1850 Wickersham Dr.<br>Anchorage, AK 99507 | do | Cook Inlet-Susitna. |
| Territorial Corp | Box 6217<br>Albuquerque, NM 87197 | do | Copper River. |
| Tuluksak Dredging Ltd. | Nyac, AK 99642 | Placer-dredge | Kuskokwim River. |
| Sand and gravel (construction): | | | |
| Alaska Aggregate Corp | 7800 Lake Otis Parkway<br>Anchorage, AK 99507 | Pit | Cook Inlet-Susitna. |
| Anchorage Sand and Gravel Co | 1813 East First Ave.<br>Anchorage, AK 99501 | Pit | Do. |
| Fairbanks Sand and Gravel Co | Box 686<br>Fairbanks, AK 99707 | Pit | Yukon River. |
| Red Samm Construction Co | Box 1954<br>Bellevue, WA 98009 | Pit | Southeastern Alaska. |
| Juneau Ready-Mix Inc | Box 270<br>Juneau, AK 99802 | Pit | Do. |
| U.S. Bureau of Land Management | Box 13, 701 C St.<br>Anchorage, AK 99513 | Pits | Various. |
| Stone (crushed): | | | |
| Aleutian Constructors | Box 4D<br>Anchorage, AK 99509 | Quarries | Do. |
| Ketchikan Ready-Mix and Quarry Inc | Box 8100<br>Ketchikan, AK 99901 | Quarry | Southeastern Alaska. |
| City of Sitka | Box 79<br>Sitka, AK 99835 | do | Do. |
| South Coast Inc | Box 8620<br>Ketchikan, AK 99901 | do | Do. |
| U.S. Forest Service, Region 10 | Box 1628<br>Juneau, AK 99802 | Quarries | Various. |
| Yutan Construction Co | Box 1775<br>Fairbanks, AK 99707 | Quarry | Yukon River. |
| Tin: | | | |
| Lost River Mining | Box 411<br>Nome, AK 99762 | Placer | Seward Peninsula. |

# The Mineral Industry of Arizona

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arizona Department of Mines and Mineral Resources for collecting information on all nonfuel minerals.**

**By Lorraine B. Burgin[1]**

The value of Arizona nonfuel mineral production was $1.48 billion in 1984, a 42% decline from the record high $2.56 billion set in 1981. Copper accounted for nearly three-fourths of the value of Arizona's nonfuel mineral production and, although output of the commodity increased in 1984, sharply lower metal prices reduced the value of copper production and its coproduct and/or byproduct metals gold, molybdenum, and silver.

Nationally, the State dropped from third to fifth place in value of nonfuel mineral production. Arizona remained in first place in copper with 68.4% of domestic production; it ranked second in molybdenum with about 23% of the national total; rose to fourth place in silver production with 9% of the Nation's output; and fell to eighth place in gold with 2.5% of that production.

**Table 1.—Nonfuel mineral production in Arizona[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays ---- thousand short tons -- | 151 | $1,425 | 138 | $819 |
| Copper (recoverable content of ores, etc.) ---- metric tons -- | 678,216 | 1,144,285 | 746,453 | 1,100,182 |
| Gem stones ---- | NA | 2,800 | NA | 2,700 |
| Gold (recoverable content of ores, etc.) ---- troy ounces -- | 61,991 | 26,284 | 51,548 | 18,591 |
| Gypsum ---- thousand short tons -- | 265 | 1,929 | 261 | 2,332 |
| Lead (recoverable content of ores, etc.) ---- metric tons -- | [r]155 | [r]74 | W | W |
| Lime ---- thousand short tons -- | 340 | 16,700 | 359 | 17,304 |
| Molybdenum (content of concentrate) ---- thousand pounds -- | 23,934 | [r]80,210 | 24,013 | 76,112 |
| Pumice ---- thousand short tons -- | 2 | 15 | 2 | 21 |
| Sand and gravel (construction) ---- do ---- | [e]23,200 | [e]75,000 | 30,439 | 101,959 |
| Silver (recoverable content of ores, etc.) ---- thousand troy ounces -- | 4,492 | 51,383 | 4,093 | 33,320 |
| Stone: | | | | |
| Crushed ---- thousand short tons -- | 4,755 | 24,079 | [e]5,200 | [e]27,300 |
| Dimension ---- do ---- | (2) | 1 | [e](2) | [e](2) |
| Combined value of cement, perlite, pyrites, salt, sand and gravel (industrial), tin (1984), and value indicated by symbol W ---- | XX | 87,449 | XX | 102,839 |
| Total ---- | XX | [r]1,511,634 | XX | 1,483,479 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Less than 1/2 unit.

## Table 2.—Value of nonfuel mineral production in Arizona, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Apache | W | W | Clays, sand and gravel (industrial), stone (crushed). |
| Cochise | $19,856 | $25,001 | Copper, lime, stone (crushed), gold, silver. |
| Coconino | 1,332 | 2,962 | Stone (crushed), stone (dimension). |
| Gila | 189,916 | W | Copper, molybdenum, stone (crushed), silver, clays. |
| Graham | 184 | 29 | Stone (crushed), pumice. |
| Greenlee | W | W | Copper, silver, gold, molybdenum, stone (crushed). |
| Maricopa | 35,718 | 2,488 | Stone (crushed), salt, clays. |
| Mohave | 1,448 | 4,721 | Stone (crushed), gold, copper, silver, lead. |
| Navajo | 1,829 | W | Stone (crushed). |
| Pima | 579,965 | 479,422 | Copper, molybdenum, cement, silver, stone (crushed), gold, clays, lead. |
| Pinal | 374,927 | 310,690 | Copper, molybdenum, gold, silver, gypsum, lime, stone (crushed), perlite, sand and gravel (industrial), pyrites, lead, clays. |
| Santa Cruz | 430 | (2) |  |
| Yavapai | 173,475 | W | Copper, cement, molybdenum, lime, silver, stone (crushed), gold, clays, gypsum. |
| Yuma | W | (2) |  |
| Undistributed[3] | 180,396 | 611,321 |  |
| Sand and gravel (construction) | XX | [e]75,000 |  |
| Stone: |  |  |  |
| Crushed | [e]22,200 | XX |  |
| Dimension | [r] [e]1 | XX |  |
| Total | [r] [4]1,581,681 | 1,511,634 |  |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4] Data do not add to total shown because of independent rounding.

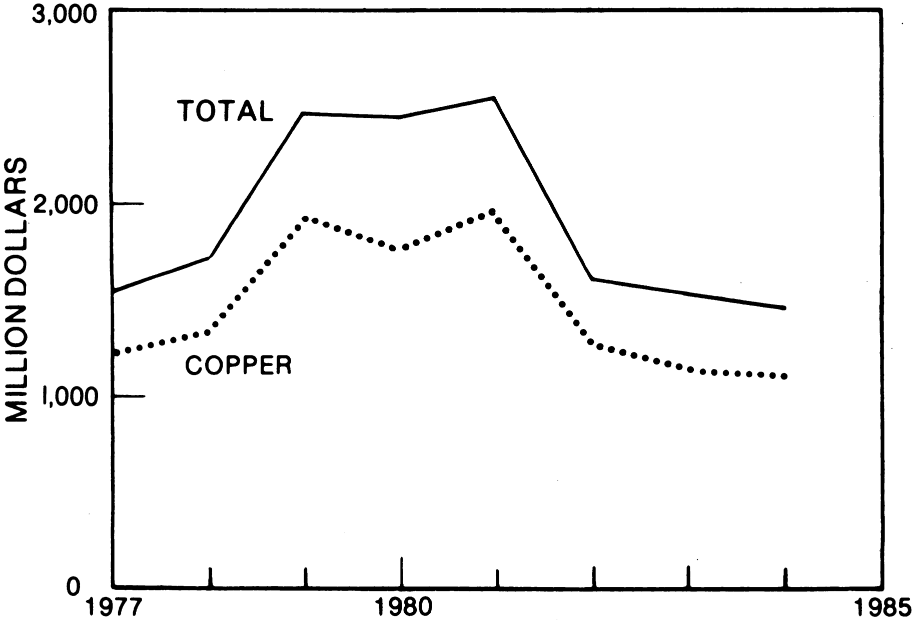

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Arizona.

## Table 3.—Indicators of Arizona business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| **Employment and labor force, annual average:** | | | | |
| Population | thousands | 2,892 | 2,970 | 3,053 |
| Total civilian labor force | do | 1,338 | 1,386 | 1,433 |
| Unemployment | do | 133 | 126 | 71 |
| **Employment (nonagricultural):** | | | | |
| Mining total[1] | do | 17.7 | 14.3 | 13.3 |
| Metal mining[2] | do | 15.5 | 12.1 | NA |
| Nonmetallic minerals except fuels[2] | do | .6 | .6 | NA |
| Manufacturing total | do | 154.5 | 155.8 | 172.3 |
| Primary metal industries | do | 7.7 | 6.5 | 7.0 |
| Stone, clay, and glass products | do | 5.2 | 6.3 | 7.3 |
| Chemicals and allied products[2] | do | 3.5 | 3.4 | NA |
| Petroleum and coal products[2] | do | .2 | .2 | NA |
| Construction | do | 64.8 | 78.6 | 96.2 |
| Transportation and public utilities | do | 56.6 | 57.2 | 60.4 |
| Wholesale and retail trade | do | 252.6 | 260.9 | 286.6 |
| Finance, insurance, real estate | do | 62.0 | 65.7 | 71.7 |
| Services | do | 221.8 | 242.2 | 274.1 |
| Government and government enterprises | do | 199.9 | 203.1 | 206.1 |
| Total[3] | do | 1,029.8 | 1,077.8 | 1,180.8 |
| **Personal income:** | | | | |
| Total | millions | $29,116 | $31,915 | $36,151 |
| Per capita | | $10,067 | $10,745 | $11,841 |
| **Hours and earnings:** | | | | |
| Total average weekly hours, production workers | | 38.9 | 40.5 | 40.8 |
| Mining (copper ores) | | 38.3 | 39.1 | 41.3 |
| Total average hourly earnings, production workers | | $8.73 | $8.99 | $9.09 |
| Mining (copper ores) | | $12.87 | $13.28 | $13.41 |
| **Earnings by industry:** | | | | |
| Farm income | millions | $306 | $288 | $407 |
| Nonfarm | do | $19,513 | $21,538 | $24,520 |
| Mining total | do | $527 | $451 | $443 |
| Metal mining | do | $455 | $385 | $374 |
| Nonmetallic minerals except fuels | do | $10 | $12 | $12 |
| Coal mining | do | W | $46 | $49 |
| Oil and gas extraction | do | W | $8 | $9 |
| Manufacturing total | do | $3,654 | $3,931 | $4,553 |
| Primary metal industries | do | $229 | $212 | $231 |
| Stone, clay, and glass products | do | $123 | $152 | $188 |
| Chemicals and allied products | do | $78 | $86 | $94 |
| Petroleum and coal products | do | $7 | $5 | $5 |
| Construction | do | $1,496 | $1,802 | $2,203 |
| Transportation and public utilities | do | $1,386 | $1,503 | $1,592 |
| Wholesale and retail trade | do | $3,404 | $3,662 | $4,226 |
| Finance, insurance, real estate | do | $1,085 | $1,337 | $1,609 |
| Services | do | $3,867 | $4,442 | $5,197 |
| Government and government enterprises | do | $3,957 | $4,267 | $4,531 |
| **Construction activity:** | | | | |
| Number of private and public residential units authorized | | 36,821 | 63,964 | 78,533 |
| Value of nonresidential construction | millions | $793.1 | $917.0 | $1,523.2 |
| Value of State road contract awards | do | $135.0 | $291.0 | $438.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 1,245 | 1,645 | 2,001 |
| **Nonfuel mineral production value:** | | | | |
| Total crude mineral value | millions | $1,581.7 | $1,511.6 | $1,483.5 |
| Value per capita | | $547 | $509 | $486 |

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

In the industrial minerals group, the leading commodities, in descending order of value, were construction sand and gravel, portland cement, crushed stone, lime, masonry cement, gem stones, gypsum, industrial sand and gravel, perlite, salt, clays, pumice, and pyrites. All commodities increased in value except clays, gem stones, pyrites, and industrial sand and gravel. In quantity of output, gains were noted for all except clays, gypsum, and pyrites; perlite, pumice, and industrial sand and gravel remained the same. Arizona continued to rank first nationally in production of gem stones.

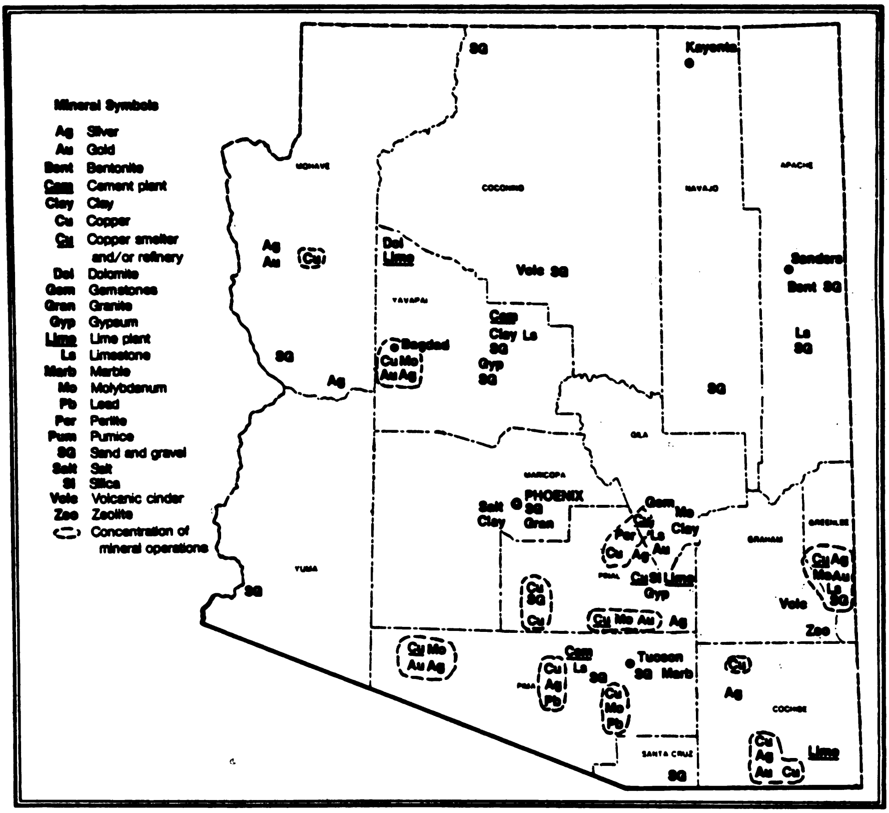

Figure 2.—Principal mineral producing localities in Arizona.

**Trends and Developments.**—Arizona's copper industry continued to deal with the lowest copper prices, in real terms, since the Great Depression, large inventories of the metal, and increased competition from imports. However, reduced losses at some operations resulted from reduction in labor costs through layoffs, shutdowns, shorter work schedules, revised mining and smelting plans, improved technology, ownership changes, and organization restructuring. Workers on strike since mid-1983 were replaced by nonstriking and new employees, often at lower wages and roduced benefits; productivity of the individual workers increased. The vulnerability of the copper industry to the economy's cyclical swings was demonstrated when one oil company placed three Arizona operations on the market; buyers failed to be attracted to another large copper, molybdenum, and silver operation on the market for the fifth straight year; and the State's largest copper producer agreed in principle to sell a one-third interest in its mine and treatment facilities to a Japanese firm.

The Environmental Defense Fund filed suit to force Phelps Dodge Corp. and Magma Copper Co. to comply with Federal clean air standards. Alleging that two company smelters emitted more than 550,000 short tons of sulfur dioxide per year, more than one-third of all sulfur emissions in the Rocky Mountain West, the fund asked that the companies be required to control emissions by 1986. Under the 1977 Clean Air Act, smelter operators were exempt from installing pollution controls if they could show financial distress and if they could meet air monitoring standards. The exemption was to extend through 1987 in the form of two 5-year waivers. The first order expired December 31, 1982; however, the Environmental Protection Agency (EPA) regulations for the second order had not been published by yearend 1984.

Concern was expressed that copper smelters in Arizona and Mexico could create serious air pollution problems along the Arizona-Mexico international border. Discussions focused on the Cananea copper smelter operated by Cía. Minera de Cananea S.A. 30 miles southwest of Douglas, the Nacozari copper smelter operated by Mexicana de Cobre S.A. 60 miles south of Douglas, both in Sonora, Mexico, and the Phelps Dodge Douglas smelter in Cochise County, Arizona. In 1984, the Douglas smelter emitted about 330,000 tons of sulfur dioxide, and the Cananea smelter, 210,000 tons; the Nacozari smelter was expected to produce 460,000 tons per year after startup in 1986. Arizona's producers were required by law to cut their sulfur dioxide emissions to 316,800 tons per year by 1988. Through 1984, Phelps Dodge spent about $385 million, in 12 years, for air quality improvement facilities at its four copper smelters, and Magma Copper had spent $50 million on environmentally related capital additions to its smelter. It was contended that Mexican smelters, seeking International Monetary Fund loans for construction, would not be subject to the same air pollution standards.

**Exploration Activities.**—According to the Arizona Department of Mines and Mineral Resources, a high level of exploration at the beginning of the year tapered off by yearend because of weakened metal markets and prices. Activity centered in the Union Pass mining district, Mohave County; in Tertiary Age detachment-fault mineralized structures, La Paz County; in exhalative gold and base metal horizons of the Precambrian schist belt, Yavapai County; and at several famous mines that had produced in the past in Yavapai and Maricopa Counties. Exploration for silver mineralization was continued in the Vekol mining district, Pinal County, and the Tombstone and Pierce districts in Cochise County. Large companies such as Inspiration Consolidated Copper Co. and Phelps Dodge searched for precious metals deposits suitable for use as a silica flux in their smelters. Magma Copper explored its copper oxide deposit in the subsidence zone over the San Manuel ore body. Uranium-bearing breccia pipes on the Colorado Plateau were targets for acquisition and drilling by Energy Fuels Nuclear Inc., Pathfinders Mines Corp., Rocky Mountain Energy Co., Uranez U.S.A. Inc., and Western Nuclear Inc.[3]

**Legislation and Government Programs.**—On May 2, 1984, the Governor signed Senate Bill 1048, which renamed the Arizona Department of Mineral Resources, the Arizona Department of Mines and Mineral Resources to promote the State's mineral resources. Duties of the department were expanded and included assisting prospectors and operators of small mines; maintaining an information bank and library of mineral and mining information, underground mine map repository files, and a mineral museum; providing quality mining data, etc., for the legislature and other agencies; surveying potential economic mineral resources; serving as a center of mining information; and publishing and disseminating information.

About 1.1 million acres administered by the U.S. Forest Service and the U.S. Bureau of Land Management (BLM) were included in the Arizona Wilderness Act of 1984 signed by the President in August. Nearly 660,000 acres were set aside as wilderness in the Apache-Sitgreaves, Coconino, Coronado, Kaibab, and Prescott National Forests; 396,000 acres in the Arizona Strip area north of the Grand Canyon; and 6,670 acres in the Arivaipa Canyon of the Sonoran Desert. In a compromise measure, more than 1 million previously undesignated acres were released for multiple use. Mining interests were concerned that many of the areas were known to have high mineral potential.[3]

The Arizona Bureau of Geology and Mineral Technology published Bulletin 194, listing Arizona mineral districts with their total production of copper, gold, manganese, molybdenum, silver, tungsten, uranium, vanadium, and zinc through 1981. Also included is a map with mining districts color coded using commodity and geological criteria.[4]

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

**Copper.**—Arizona copper production increased about 10%; however, the value of its output declined nearly 4% because of the further drop in the price of copper. The average cathode price fell from $0.77 per pound in 1983 to $0.67 in 1984. Of the 22 large-scale copper mines operating in 1981, two were permanently closed by 1984, the Sacaton and Bluebird, and 9 were shut down indefinitely, the Christmas, Cyprus Johnson, Esperanza, Lakeshore, Magma, Mineral Park, New Cornelia, Silver Bell, and Twin Buttes. Of the latter group, all except Christmas and Magma continued to recover copper at precipitation or electrowinning facilities in 1984. A significant rise in output at Esperanza, Morenci, Pinto Valley, Ray Mines, Sierrita, and Silver Bell resulted in an increase in the value of Arizona's copper production, even though the value of copper production declined at Bagdad, Inspiration, Johnson, Lakeshore, Miami, Mission, New Cornelia, Sacaton, San Manuel, San Xavier, and Twin Buttes.

Copper was produced at 28 operations in the following counties, in descending order of output, Pima, Greenlee, Pinal, Gila, Yavapai, Cochise, Mohave, Graham, Yuma, and La Paz. Of these, 14 were small operations treating or selling less than 100,000 tons of material per year. The large operations are discussed in the following section where all quantities are in short tons unless otherwise noted.

Amoco Minerals Co., a subsidiary of Standard Oil Co. (Indiana), through its subsidiary Cyprus Mines Corp., managed Cyprus Bagdad Copper Corp., Cyprus Pima Mining Co. (owned 75.01% by Amoco and 24.99% by Utah International Corp.), and Cyprus Johnson Copper Co.

The Cyprus Bagdad operation at Bagdad, Yavapai County, 120 miles northwest of Phoenix and 60 miles west of Prescott, included an open pit copper mine, a 55,000-ton-per-day sulfide ore concentrator, and an oxide ore heap-leaching system with a solvent extraction-electrowinning (SX-EW) plant producing electrowon copper cathode. Twenty percent of its copper concentrates were contracted to be shipped to Mitsui Mining & Smelting Co. Ltd., Japan, through 1987, and from 60% to 78% of the concentrates were to be sent for smelting and refining either to Inspiration or Magma Copper through 1986. Molybdenum concentrates were toll roasted at several European and U.S. plants, and marketed by Phillip Bros. Inc.

Depressed copper prices led Cyprus Bagdad to cut production by one-fourth in January and then to shut down the mine and mill from February until late October; the SX-EW plant, however, was operated at near capacity during the year. Operations were resumed at 75% of capacity, and a program instituted to reduce smelting and refining costs, labor and transportation costs, power rates, and property taxes. Of the 625 workers laid off in February, about 350 were recalled to restart the mine and concentrator; 150 had been retained for maintenance duties to operate the electrowinning facilities. The company reported unit cash costs were reduced 30%, and the installation was operated above cash breakeven levels. With the mine closure, copper production was reduced from a normal 175 million pounds per year to nearly 48 million pounds, according to Cyprus Minerals Co.

The Cyprus Johnson operation, 20 miles east of Benson, Cochise County, consisted of an open pit mine, heap leach, and SX-EW plant. Waste stripping and open pit mining were halted in 1983. Leaching of previously stockpiled ore and recovery of copper at the SX-EW plant continued in 1984, producing 8.8 million pounds of copper. Plans were to continue leaching through the third quarter of 1985 when, because of limited ore reserves, operations will be suspended and all fixed assets and supplies sold or transferred to other properties.

The Cyprus Pima open pit copper mine and 32,500-ton-per-day concentrator about 16 miles south of Tucson, Pima County, was shut down in October 1982, and remained on a maintenance status. Since its closure, the company's product inventory was sold, and in 1984, most mobile mining equipment and materials and supplies inventories were being sold or transferred.

Production of copper ore at all of Amoco's Arizona properties totaled 56.6 million pounds in 1984, compared with 171.8 million pounds in 1983 and 223.4 million pounds in 1982. As of December 31, 1984, Standard Oil of Indiana's 1984 annual report estimated its copper ore reserves in Arizona totaled 436 million tons of 0.44% copper, compared with 508.4 million tons of 0.47% copper in 1983. Copper reserve additions at the Bagdad Mine totaled 55.2 million tons in 1984 and copper reserves of 123.2 million tons at the Pima and Johnson Mines were eliminated from the 1984 amount since they were no longer considered to be economically recoverable.[5]

Anamax Mining Co., equally owned by AMAX Inc. and Anaconda Minerals Co., a wholly owned subsidiary of the Atlantic Richfield Co. (ARCO), operated the Twin Buttes Mine 25 miles south of Tucson, Pima County. This operation included an open pit mine, a 45,000-ton-per-day sulfide ore concentrator, a 10,000-ton-per-day ion-exchange electrowinning plant for processing solutions from leached copper oxide ores, and a uranium oxide plant. Anamax's share of ores from the Eisenhower Mining Co.'s Eisenhower (Palo Verde) property was treated at the Twin Buttes sulfide concentrator. Anamax was responsible for operating the oxide plant and producing electrowon cathode copper; however, each partner purchased and sold its own share of cathode copper.

According to the AMAX 1984 10K Annual Report to the Securities and Exchange Commission, the only production at the Twin Buttes Mine was from the oxide plant at which 25,120 net tons of copper was recovered in 1984, compared with 25,324 net tons in 1983. The Twin Buttes Mine, sulfide mill, and concentrator remained idle throughout 1984. From August 1983 through November 1984, management personnel operated the ion-exchange electrowinning plant using feed from stockpiled oxide ores.

In October, Anamax reorganized its Twin Buttes operation, roduced oxide plant output, and began the layoff of 187 salaried workers. Of the 275 management employees that had operated the facilities since the strike began in August 1983, 22 were laid off indefinitely November 16, 122 in early December, and 41 furloughed after project work was completed. About 100 striking hourly workers were recalled under an imposed contract that cut wages from nearly $13.50 per hour under the old contract to $8.25 per hour. In 1981, the mine employed 1,100 hourly and 400 salaried workers.

The AMAX 1984 annual report showed the AMAX share of ore reserves was estimated to be 106 million tons of sulfide ore with an average grade of 0.69% copper in the Twin Buttes and Palo Verde deposits, as of December 31, 1984. Oxide ore reserves were estimated to be 16 million tons of 0.82% copper.

Following an October 1979 Federal Trade Commission order based on antitrust grounds requiring ARCO to divest most of its interest in Anamax within 5 years, ARCO continued, unsuccessfully, to seek a purchaser of that interest. AMAX agreed in principle to a cooperative effort with ARCO in the possible sale of Anamax.

Eisenhower Mining, under an Anamax and ASARCO Incorporated equal partnership, mined the Eisenhower (Palo Verde) copper deposit 6.5 miles north of the Twin Buttes Mine between Asarco's Mission and San Xavier open pit mines. Because of the shutdown of the Anamax concentrator, Asarco treated 6,713,000 tons of Eisenhower ores at its Mission concentrator. Asarco estimated the partnership's total ore reserves at yearend were 13 million tons containing 0.67% copper and 0.14 troy ounce of silver per ton. During the year, Anamax and Asarco agreed to defer shipment of the Eisenhower ores to the Twin Buttes concentrator until 1987. The more than 100% increase in Eisenhower ores processed through Asarco's concentrator yielded 37,100 tons of copper and 596,000 ounces of silver.

Asarco owned and operated the Mission

and San Xavier open pit mines and the Mission 22,500-ton-per-day concentrator near Sahuarita, Pima County, about 15 miles south of Tucson; the Sacaton open pit mine and 11,000-ton-per-day concentrator, about 3 miles northwest of Casa Grande, Pinal County; and the Silver Bell open pit mine and 11,400-ton-per-day concentrator at Silver Bell, Pima County, 38 miles northwest of Tucson. Concentrates were treated at the Asarco 175,000-ton-per-year smelter at Hayden, Gila County, where blister copper was produced and copper anodes cast for shipment to its refinery at Amarillo, TX.

The Asarco 1984 annual report noted production at its Arizona properties as follows:

1. Mission treated 1,301,000 tons of ore, recovering 10,400 tons of copper and 188,000 ounces of silver.
2. A total of 2,329,000 tons of San Xavier ore was processed through the Mission concentrator, yielding 9,400 tons of copper and 103,000 ounces of silver.
3. Sacaton treated 1,000,000 tons of ore, recovering 4,500 tons of copper, 33,000 ounces of silver, and 479 ounces of gold.
4. Silver Bell recovered 2,272,000 tons of copper and 102,000 ounces of silver.

As of December 31, 1984, Asarco estimated reserves at its Arizona properties as follows: San Xavier, 157 million tons of 0.51% copper and 0.08 ounce of silver per ton; Mission, 78 million tons of 0.76% copper and 0.17 ounce of silver per ton; and Silver Bell, 21 million tons of 0.68% copper and 0.07 ounce of silver per ton.

After posting net earnings of $58.3 million in 1983, Asarco reported a net loss of $306 million in 1984, including an unusual $254 million pretax loss, which reflected the closing or shutdown of certain facilities and the writedown of some properties no longer considered economic. On November 30, Asarco announced a plan to replace a portion of the salaried employees' pay with stock and a 4% to 10% cut in pay, with the highest income giving up the most pay. The action was deemed necessary to preserve the strength of the company.

Asarco reported its Mission complex, which included the adjacent Mission, Eisenhower, and San Xavier Mines, reduced costs of producing a pound of copper by about 28% between 1981 and yearend 1984. During that period, the Mission haulage fleet and flotation cells at the concentrator were modernized and, in 1984, an agreement with Asarco's partner in the Eisenhower venture permitted changing the mining plan to reduce the amount of overburden to be stripped from the ore bodies. At its Mission Mine, Asarco recalled 70 workers on April 1 for mine stripping operations necessary to maintain full capacity of the concentrator. However, in September and October, the continuing slump in copper prices forced the company to lay off 120 hourly workers and to operate with 280 hourly and 122 salaried employees.

On August 15, the Silver Bell Mine was shut down after having been reopened just 10 months; previously, low copper prices closed the mine from December 1981 to October 1983. About 170 workers were laid off, and 15 to 18 workers were retained to continue the leaching operations and maintain other facilities. Annual copper output was expected to fall from 21,000 tons to 5,000 to 6,000 tons; production costs were reduced from 88.6 cents per pound in 1983 to 71 cents in 1984.[6]

The Sacaton open pit mine was closed on March 31 owing to exhaustion of ore reserves. The concentrator was mothballed and 190 workers laid off. Normal production was about 21,000 tons per year. A major revegetation of waste dumps and tailings ponds requiring irrigation equipment and chainlink fence was under way on the property. Asarco recorded a $35 million pretax writeoff on the property because the underground copper property at Sacaton could not be profitably mined at then foreseeable copper prices.

Asarco's Hayden smelter reached its highest monthly operating rate in 10 years with the Inco-type oxygen-enriched flash furnace, which started up in November 1983. The new energy-efficient furnace eliminated production curtailments used for air quality control purposes. During the year, the smelter had no violations for sulfur dioxide ambient air standards and was the first in Arizona to meet Federal and State air pollution standards. Flash-furnace startup problems included frequent shutdowns for cleaning the dust handling system, and in November, the premature failure of furnace brick necessitated a 6-week shutdown to reline the furnace. Concentrate feed for the smelter was supplied by Ray Mines, Mission Mine, Troy Mine (Montana), and Silver Bell Mine.

Duval Corp., a subsidiary of Pennzoil Co., operated the Sierrita open pit copper-molybdenum mine and 85,000-ton-per-day concentrator 30 miles south of Tucson, Pima County. The Copper Leach Electrolysis and Regeneration (CLEAR) hydrometallurgical plant, shut down in April 1982, was permanently retired at yearend 1984. The Esperanza open pit copper-molybdenum mine, adjacent to the Sierrita pit, and its 15,000-ton-per-day concentrator remained shut down. Esperanza's crusher, however, was reactivated to increase the capacity at the Sierrita concentrator, which reached a 1-day record high of 101,000 tons on November 13. The Mineral Park open pit molybdenum-copper mine and 15,000-ton-per-day concentrator operation 15 miles north of Kingman remained idle. Precipitate plants at Esperanza and Mineral Park continued to produce cement copper.

The Sierrita Mine operated most of the year at 90% capacity; at yearend, about 750 hourly and 250 salaried workers were employed, down from a peak of 2,500 in 1981. Hourly employees continued to work through 1984 without renewing the labor contracts that expired September 30, 1983. In October 1984, after reaching an impasse in negotiations with its union representatives, the company imposed a 15% wage cut; however, to compensate for the lower wages, employees worked overtime two extra 8-hour shifts per month. Increased productivity of the work force reduced throughput costs per ton of ore milled to about $3.30, compared with $5.19 per ton in 1981, the last full year of production.[7]

The Pennzoil board of directors voted, on November 8, to have its Duval subsidiary sell off its base and precious metals and potash operations and properties in Arizona, New Mexico, and Nevada. In 1984, the Pennzoil metals division posted losses of $16 million after taxes, compared with $16.3 million in 1983 and $30 million in 1982. Pennzoil wrote down its metal assets approximately $100 million ($67 million after taxes) in 1984 and restructured its company to concentrate on petroleum and sulfur production.[8]

Inspiration, a subsidiary of Inspiration Resources Corp., properties included the Joe Bush-Thornton and Live Oak-Red Hill-Bluebird open pit mines in the Miami area, Gila County. In the Miami area, the operation included crushing facilities, a 20,000-ton-per-day concentrator, a smelter with a rated annual capacity of 110,000 tons of copper in concentrate, a sulfuric acid plant, a solvent-extraction plant, an electrowinning and electrorefining tankhouse, and a continuous-cast rod-fabricating plant. Inspiration also smelted copper-bearing materials and, to a lesser extent, provides refining and rod-fabricating services for other copper producers under toll contracts or by purchases of concentrates. The company's Christmas open pit and underground mines and 5,500-ton-per-day concentrator 35 miles south of Miami, Gila County, and its Sanchez copper exploration project near Safford, Graham County, continued inactive.

In July 1984, Inspiration acquired the adjacent Bluebird property from Ranchers Exploration and Development Corp. The operation, consisting of an open pit mine, leach pads, and an SX-EW plant, had been idle since 1982. Although Inspiration did not plan to reactivate the facilities, the area was to be used to place leach materials from other mines. Acquisition of the property, with a boundary common to Inspiration, would not only provide additional reserves, but made available Inspiration reserves previously considered inaccessible.

The Inspiration Resources 1984 10K Annual Report showed the Inspiration area mines produced 14,944,000 tons of ore containing 0.526% copper and 25,671,000 tons of waste in 1984, compared with 14,724,000 tons of ore containing 0.525% copper and 23,718,000 tons of waste in 1983. At the smelter, 107,000 tons of Inspiration's own copper concentrates were treated in 1984, compared with 104,000 tons in 1983; toll and purchased concentrates rose to 250,000 tons in 1984, compared with 96,000 tons in 1983. Copper production from the refinery rose to 84,804 tons in 1984, compared with 81,123 tons in 1983, and from the rod plant, increased to 95,231 tons in 1984, compared with 91,303 tons in 1983. Total copper recovered from the Inspiration area mines increased to 75,490 tons in 1984 from 69,313 tons in 1983.

As of December 31, 1984, the company reported estimates of 233 million tons of 0.55% copper in proven reserves and 18 million tons of 0.57% copper in probable reserves at its Inspiration mines. Estimated ore reserves at the Christmas, Ox Hide, and Sanchez Mines remained the same as in 1983.

Inspiration incurred an operating loss of $9 million in 1984, compared with an operating loss of $18.6 million in 1983. Net sales increased from $161 million in 1983 to $163 million in 1984.

In addition to smelting ores and concentrates from its own properties, Inspiration processed concentrates from Duval's Sierrita Mine beginning in early 1984, and from Amoco's Cyprus Bagdad operation starting in September. The long-term contract to treat concentrates from the nearby Pinto Valley Copper Corp. operation was terminated early in 1984. In May 1984, Amoco and Inspiration terminated their August 1983 agreement to form a 50-50 partnership in the Inspiration smelter, and plans to increase production and to modernize the smelter were put on hold. As a means of coping with reduced supplies of copper concentrates while still containing costs of operating the smelter, a new two-converter program for the smelter was instituted in the spring. The system allowed the smelter to run 350 days per year rather than the intermittent 200 to 250 days previously scheduled because of lack of concentrates.

In other cost-reducing measures, 192 workers were laid off at Inspiration, bringing the total number employed to approximately 1,200, compared with 2,250 in 1981.

In environmental matters, the Arizona Department of Health Services cited the company 16 times for exceeding health standards for sulfur dioxide emissions in 1984 and for failing to install the required emissions-monitoring equipment at its smelter. Most violations occurred in November when the acid plant was shut down for repairs.

The development of a trim blast design to improve the stability of a final pit wall at the Inspiration Mine was described.[9]

Kennecott, a subsidiary of Standard Oil Co. of Ohio (Sohio), operated the Ray Mines Div. in Arizona. The installations included an open pit copper mine, a 15,000-ton-per-day silicate ore vat leach, a solvent-extraction plant, and a 14,000-ton-per-day electrowinning refinery near Ray, Pinal County, and 22 miles to the southeast, a 27,000-ton-per-day concentrator, a smelter with an annual capacity of 80,000 tons of copper anode, and a sulfuric acid plant at Hayden, Gila County.

According to the Sohio 1984 10K Annual Report, Ray Mines produced 98,100 net tons of copper in 1984, compared with 46,163 net tons in 1983 and 111,267 net tons in the peak year of 1981. Ores mined and treated increased to 11,756,000 net tons in 1984, compared with 4,346,000 net tons in 1983 and 14,816,000 net tons in 1981. The average ore grade was 1.109% copper in 1984, compared with 1.187% in 1983 and 0.969% in 1981.

Ray Mines Div. operated at close to full capacity compared with 1982 and 1983 when the operation was shut down from May 1982 until September 1983. The silicate ore vat leach, electrowinning refinery, and Kennecott's Hayden smelter, however, remained closed throughout 1984, and concentrates produced at Ray Mines were sold to Asarco for treatment at the Asarco Hayden smelter.

Owing principally to lower copper prices, Kennecott's operating loss at properties in five States increased from $91 million in 1983 to $160 million in 1984.

Newmont Mining Corp. owned two subsidiaries in Arizona: Magma Copper and Pinto Valley Copper. Magma Copper operated the San Manuel Div. at San Manuel, Pinal County, 43 miles northeast of Tucson, and the Superior Div. at Superior, Pinal County, 60 miles east of Phoenix. Pinto Valley Copper was headquartered near Globe, and the operations were about 6 miles west of Miami, Gila County.

Magma Copper's San Manuel Div. comprised an underground mine, a 64,000-ton-per-day concentrator, a smelter with a 200,000-ton annual capacity of copper anode, and a 125,000-ton-per-year continuous-cast rod plant. According to the 1984 Newmont annual report, the San Manuel Mine operated at 90% capacity, producing 20.4 million tons of ore averaging 0.638% sulfide copper, compared with 18.3 million tons of 0.642% sulfide copper in 1983. Copper contained in the concentrates rose to 120,345 tons, byproduct silver production increased to 502,072 ounces, and molybdenum sulfide to 3,695 pounds; gold output, however, declined to 24,892 ounces.

Suffering its fourth consecutive year of losses, $44 million in 1984, Magma Copper sharply reduced development work at the San Manuel Mine and ceased development work on the deeper Kalamazoo ore body. In a further effort to cut costs, the company sought unsuccessfully to renegotiate its 1983 labor contract. More than 3,456 workers were employed at the San Manuel operation, down about 1,500 from the peak reached in 1981.

The feasibility of open pit mining oxide ore over the San Manuel Mine subsidence area and of constructing a leach pad and SX-EW plant to recover the copper were investigated as a future method of reducing costs at the Nation's largest underground copper operation. The in situ leach of oxide ores in the same general area was also considered. Intensive studies were under way on the practicality of retrofitting the San Manuel smelter, at a cost of $150 million, to meet sulfur emission requirements of the Clean Air Act by 1988.

The Newmont 1984 annual report showed San Manuel proven reserves at yearend were estimated to be 312.6 million tons averaging 0.694% copper, 0.028% molybdenum sulfide, 0.029 ounce of silver, and 0.00158 ounce of gold. At the deeper Kalamazoo ore body, ore reserves were 354.9 million tons of 0.715% copper and byproducts the same grade as the San Manuel ore body. The San Manuel and Kalamazoo ore reserves include 98 million and 101 million tons, respectively, contained in a shaft pillar; removal of these reserves would require additional shaft entries. San Manuel oxide proven and probable reserves were estimated to be 57 million tons of 0.468% copper, not including 230 million tons averaging 0.37% copper oxide contained in the mine's subsidence area, which may be recovered in the future by in situ leaching methods.

The Superior Div.'s high-cost underground Magma Mine and concentrator, which were shut down in August 1982, remained on a care-and-maintenance status throughout 1984. Magma Copper reported that because the mine was inactive ore reserves remained at 4.4 million tons and averaged 5.69% copper, 0.026 ounce of gold per ton, and 0.71 ounce of silver per ton.

Pinto Valley Copper was incorporated by Newmont in 1983 following its acquisition of the Cities Service Co.'s mining assets in Arizona. The operations included the Pinto Valley open pit copper mine, a 50,000-ton-per-day concentrator, a 33,000-pound-per-day SX-EW plant west of Miami; another SX-EW plant at Miami for treating leach solutions from the Miami Mine; the old Miami underground copper mine that was converted to a leach operation in 1959; the inactive Copper Cities open pit mine and its leaching facilities; and the Miami East underground mine on care-and-maintenance status throughout the year.

Newmont reported the nearly 11.3 million tons of Pinto Valley ore, averaging 0.437% copper, treated in 1984 yielded 43,706 tons of copper, 155,308 ounces of silver, and 2,951 ounces of gold. Leaching and SX-EW facilities operated throughout 1984, producing 12,801 tons of copper.

Closed since July 1982, the Pinto Valley open pit mine and concentrator were reactivated when several cost-reducing measures were taken. Labor unions agreed to accept a wage reduction of $2.00 per hour during the 6-month startup period, and approximately 375 workers were recalled. The mine plan was revised to reduce stripping and the higher cost toll smelting and refining contract existing under the previous ownership was canceled. Concentrates were then shipped to the Magma Copper smelter at San Manuel.

At yearend, Newmont estimated reserves of 373 million tons of 0.403% copper and 0.015% molybdenum at the Pinto Valley Mine and nearly 6 million tons of 3.14% copper at the Miami East Mine.

In 1984, Newmont posted a $44.1 million loss before taxes at its Magma Copper operations, compared with $53.3 million in 1983; Pinto Valley Copper's losses were $9.1 million, compared with $1.1 million in 1983. Although Newmont's net income of $41 million in 1984 was down from the $53.3 million posted in 1983, the corporation was one of the few natural resource companies showing a profit, chiefly because of its diversification in the production of oil, gas, coal, and gold.[10]

Noranda Lakeshore Mines Inc., a subsidiary of Noranda Mines Ltd., Toronto, Canada, operated the Noranda Lakeshore Mine 28 miles southwest of Casa Grande, Pinal County, on the Papago Indian Reservation. After conversion of its underground mine and vat-leach facility to an in situ leach and SX-EW operation in 1984, Noranda reported recovering 7,701 tons of copper from its in situ leach, compared with 18,760 tons of copper recovered by vat leaching 1,297,000 tons of ore in 1983. At yearend, oxide ore inventories remained an estimated 13 million tons of 1.16% copper. Inventory estimates of sulfide ore in the tactite zone remained at 9 million tons of 1.35% copper and in the porphyry zone at 41 million tons of 0.65% copper.

Phelps Dodge ranked first in copper production with more than 29% of Arizona's total and about 20% of the newly mined copper produced in the United States. The company owned and operated the Morenci-Metcalf open pit mine in Greenlee County, 169 miles northeast of Tucson; the New Cornelia open pit mine at Ajo, Pima County, 106 miles southwest of Phoenix; and the Copper Queen Branch leaching and precipitation operation at the permanently shutdown Lavender Pit and the underground Copper Queen Mine at Bisbee, Cochise County. The Safford Branch copper deposit near Safford, Graham County, and the copper deposit in Copper Basin southwest of Prescott were in the developmental and land acquisition stages, respectively.

For the third consecutive year, the corporation reported a net loss; in 1984, the net loss from continuing operations before taxes reached $267.8 million, compared with $63.5 million in 1983 and $74.3 million in 1982. In 1984, the loss included a nonrecurring pretax charge of $195 million, reflecting a writeoff of smelter equipment and other facilities rendered obsolete partially by environmental regulations, the shutdown of certain mining and smelting operations, and a writedown of its uranium producing subsidiary, Western Nuclear. Primary metal losses continued to be attributed to over production of foreign state-owned copper producers and the strength of the U.S. dollar in relation to other currencies, causing low copper prices. Somewhat improved conditions at the Morenci Mine brought Phelps Dodge's production of copper in Arizona to 242,600 tons, compared with 218,100 tons in 1983, 126,800 tons in 1982, and more than 233,800 tons in 1981.

In its 1984 annual report, the company estimated ore reserves at its Morenci-Metcalf Mine as 814 million tons of 0.76% copper; at its Western Copper property adjoining Morenci-Metcalf, 184 million tons of 0.64% copper; at its New Cornelia (Ajo) Mine, 209 million tons of 0.50% copper; at Safford (underground development), 262 million tons of 0.88% copper; and at Copper Basin, 175 million tons of copper-bearing material averaging 0.55% copper and 0.021% molybdenum.

At Morenci, the Phelps Dodge operation included the Morenci-Metcalf Mine comprising the Morenci open pit and the adjacent Metcalf open pit, formerly operated as separate mines; a 60,000-ton-per-day concentrator at the Morenci Mine and a 40,000-ton-per-day concentrator at the Metcalf; leaching and precipitation plants; and a 160,000-ton-per-year smelter. Mining at the Metcalf pit was suspended at yearend 1983, and all production in 1984 was from the Morenci Mine. The Morenci smelter was idled at the end of the year when smelting requirements were reduced because of the shutdown of the New Cornelia Mine and the termination of the Amoco (Bagdad) contract. The expenditure of another $50 million would be required to bring the smelter into compliance with environmental regulations, and the smelter was expected to remain down until air quality standards could be met. Fines for violations of the ambient air standard for sulfur dioxide at Morenci in 1984 totaled $135,000. In 1984, with a work force that averaged 2,040 employees, compared with 3,230 in 1981, Morenci brought production up to nearly 217,000 tons of copper, surpassing the 194,000 tons of copper recovered in 1981.

At Ajo, Phelps Dodge operated the New Cornelia open pit copper mine, a 28,000-ton-per-day concentrator, and a smelter with an annual capacity of 50,000 tons of copper anode. In August, the mine and concentrator were shut down until the price of copper was firmly above 80 cents per pound. About 500 workers were laid off and 180 were retained for care and maintenance. After being closed since April 1982, the Ajo smelter reopened on May 16 and continued in operation the remainder of the year to process ores from other Phelps Dodge operations. About 100 hourly and 19 salaried workers were employed. According to a consent decree agreed upon by Phelps Dodge and the EPA in 1981, and amended in 1984, the Ajo smelter was to be in full compliance with regulations limiting emissions of sulfur dioxide by January 1984, and with requirements for particulate matter by yearend 1985.

Ores and concentrates were processed at the Douglas smelter throughout 1984; however, because the cost of installing environmental protective equipment cannot be economically justified, the corporation expects to close the facility by the end of 1987.

Phelps Dodge temporarily closed its Ash Peak silica flux mine on August 12 because of low silver prices. Situated between Safford and Duncan, the mine provided flux for the Morenci and Hidalgo smelters for 4 years.

The company's deep, low-grade sulfide copper mine near Safford was allowed to flood in August. Development of the Phelps Dodge low-grade sulfide copper deposit at Copper Basin depends on higher copper prices and land exchanges between the U.S. Forest Service and the BLM. The land exchange was delayed 18 months when the Forest Service requested an Environmental Impact Statement. Some Prescott residents protested the close proximity of the potential open pit copper mine.

Continental Materials Corp. wrote off its Oracle Ridge Mining Partners copper venture in the third quarter of 1984. Owned 45% by Continental Materials and 55% by Union Minière SA of Brussels, Belgium, the mine was 20 miles south of Oracle, Pima County, on the northeastern slope of Marble Peak in the Santa Catalina Mountains. Development work was completed in 1983, and because of low copper prices, the property was placed on a care-and-maintenance basis. In 1982, the company estimated reserves at 11 million tons of ore at 2.25% copper, with small amounts of silver and gold.

### Table 4.—Arizona: Production and value of copper in Arizona and the United States

| Year | Arizona copper production | | U.S. copper production | | Arizona |
|---|---|---|---|---|---|
| | Quantity (metric tons) | Value (thousands) | Quantity (metric tons) | Value (thousands) | Percent of U.S. copper production |
| 1980 | 770,118 | $1,738,908 | 1,181,116 | $2,666,931 | 65.2 |
| 1981 | 1,040,813 | 1,953,142 | 1,538,160 | 2,886,440 | 67.7 |
| 1982 | 769,521 | 1,235,055 | 1,146,975 | 1,840,856 | 67.1 |
| 1983 | 678,216 | 1,144,285 | 1,038,098 | 1,751,476 | 65.3 |
| 1984 | 746,453 | 1,100,182 | 1,091,284 | 1,608,422 | 68.4 |

### Table 5.—Arizona: 15 leading copper producing mines in 1984, in order of output

| Rank in 1984 | Rank in 1983 | Mine | County | Operator | Source of copper |
|---|---|---|---|---|---|
| 1 | 1 | Morenci | Greenlee | Phelps Dodge Corp | Copper ore and precipitates. |
| 2 | 2 | San Manuel | Pinal | Magma Copper Co | Copper ore and tailings (slag). |
| 3 | 6 | Ray | do | Kennecott | Copper ore and precipitates. |
| 4 | 5 | Sierrita | Pima | Duval Corp | Copper ore. |
| 5 | 4 | Inspiration | Gila | Inspiration Consolidated Copper Co. | Do. |
| 6 | 15 | Pinto Valley | do | Pinto Valley Copper Corp | Do. |
| 7 | 7 | Eisenhower | Pima | Eisenhower Mining Co | Do. |
| 8 | 9 | Twin Buttes | do | Anamax Mining Co | Do. |
| 9 | 8 | New Cornelia | do | Phelps Dodge Corp | Copper ore and precipitates. |
| 10 | 3 | Bagdad | Yavapai | Cyprus Bagdad Copper Co | Copper ore. |
| 11 | 14 | Silver Bell | Pima | ASARCO Incorporated | Copper ore and precipitates. |
| 12 | 10 | Mission | do | do | Copper ore. |
| 13 | 13 | San Xavier | do | do | Do. |
| 14 | 11 | Lakeshore | Pinal | Noranda Lakeshore Mines Inc. | Do. |
| 15 | 18 | Esperanza | Pima | Duval Corp | Copper precipitates. |

### Table 6.—Arizona: Material handled and copper produced at 16 leading copper open pit and underground mines

| Mine | Ore mined (thousand metric tons) | | Waste material removed (excluding material placed in leach dumps) (thousand metric tons) | | Material placed in leach dumps (thousand metric tons) | | Total copper produced[1] (metric tons) | |
|---|---|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| OPEN PIT | | | | | | | | |
| Morenci | 31,209 | 34,323 | 8,216 | 12,140 | 11,731 | 18,783 | 161,646 | 216,577 |
| Ray | 3,943 | 10,665 | -- | -- | 7,317 | 22,456 | 35,097 | 91,538 |
| Sierrita | 18,804 | 26,476 | 6,072 | 18,565 | 67 | -- | 59,149 | 78,984 |
| Inspiration | 6,426 | 5,983 | 7,498 | 12,517 | 20,608 | 17,205 | 63,697 | 69,879 |
| Pinto Valley | -- | 10,207 | -- | 1,890 | -- | 5,997 | 6,962 | 47,201 |
| Eisenhower | 5,623 | 6,090 | 6,995 | 9,218 | -- | -- | 34,616 | 33,646 |
| Twin Buttes | 653 | -- | 753 | -- | 18 | -- | 28,719 | 22,788 |
| New Cornelia | 7,278 | 5,255 | 2,151 | 3,068 | -- | -- | 33,807 | 23,285 |
| Bagdad | W | 4,032 | NA | 3,670 | NA | 343 | W | 21,660 |
| Silver Bell | 787 | 2,046 | 845 | 2,398 | 454 | -- | 8,174 | 15,089 |
| Mission | 3,622 | 1,180 | 9,132 | ([2]) | -- | -- | 21,755 | 9,469 |
| San Xavier | 2,526 | 2,113 | 2,416 | 4,168 | -- | -- | 10,236 | 8,598 |
| Esperanza | -- | -- | -- | -- | -- | 2,057 | W | 4,235 |
| Miami | -- | -- | -- | -- | -- | -- | W | 4,061 |
| UNDERGROUND | | | | | | | | |
| San Manuel | 16,576 | 18,447 | -- | -- | -- | -- | 100,419 | 107,006 |
| Lakeshore | 965 | -- | -- | -- | -- | -- | 17,019 | 6,987 |

NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Gross metal content.

[2] Included with waste material removed from Eisenhower Mine.

## Table 7.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

| County | Mines producing[1] |  | Material sold or treated[2] (metric tons) | Gold |  | Silver |  |
|---|---|---|---|---|---|---|---|
|  | Lode | Placer |  | Troy ounces | Value | Troy ounces | Value |
| 1982, total | 33 | -- | 123,098,309 | 61,050 | $22,949,307 | 6,309,327 | $50,159,151 |
| 1983, total | 27 | 1 | 122,743,740 | 61,991 | 26,284,184 | 4,491,532 | 51,383,123 |
| 1984: |  |  |  |  |  |  |  |
| Cochise | 2 | -- | W | W | W | W | W |
| Gila | 3 | -- | W | -- | -- | W | W |
| Graham | 1 | -- | W | W | W | W | W |
| Greenlee | 2 | -- | W | W | W | W | W |
| La Paz | 1 | -- | W | W | W | W | W |
| Mohave | 1 | -- | W | W | W | W | W |
| Pima | 7 | -- | 46,258,317 | W | W | 1,932,974 | 15,735,684 |
| Pinal | 5 | -- | W | W | W | 1,110,680 | 9,041,668 |
| Yavapai | 1 | -- | W | -- | -- | -- | -- |
| Yuma | 1 | -- | W | W | W | W | W |
| Total | 24 | -- | [3]125,687,818 | [3]51,548 | [3]18,591,200 | [3]4,093,036 | [3]33,320,014 |

| County | Copper |  | Lead |  | Zinc |  | Total value |
|---|---|---|---|---|---|---|---|
|  | Metric tons | Value | Metric tons | Value | Metric tons | Value |  |
| 1982, total | 769,521 | $1,235,054,884 | 359 | $202,414 | -- | -- | $1,308,365,756 |
| 1983, total | 678,216 | 1,144,284,633 | [r]155 | [r]74,001 | -- | -- | [r]1,222,025,941 |
| 1984: |  |  |  |  |  |  |  |
| Cochise | W | W | -- | -- | -- | -- | W |
| Gila | W | W | -- | -- | -- | -- | W |
| Graham | W | W | -- | -- | -- | -- | W |
| Greenlee | W | W | W | W | -- | -- | W |
| La Paz | -- | -- | W | W | -- | -- | W |
| Mohave | W | W | W | W | -- | -- | W |
| Pima | 191,410 | 282,115,059 | W | W | -- | -- | W |
| Pinal | W | W | W | W | -- | -- | W |
| Yavapai | W | W | -- | -- | -- | -- | W |
| Yuma | W | W | W | W | -- | -- | W |
| Total | [3]746,453 | [3]1,100,181,923 | W | W | -- | -- | W |

[r] Revised. W Withheld to avoid disclosing company proprietary data.

[1] Operations at which metals were recovered only from tailings or precipitates are not counted as producing mines.

[2] Does not include gravel washed.

[3] Includes items indicated by symbol W.

## Table 8.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by class of ore or other source material

| Source | Number of mines[1] | Material sold or treated (metric tons) | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|---|---|
| Lode ore: |  |  |  |  |  |  |  |
| Gold | 1 | W | W | W | -- | -- | -- |
| Gold-silver | 2 | W | W | W | W | -- | -- |
| Silver | 3 | W | W | W | W | W | -- |
| Total | 6 | W | W | W | W | W | -- |
| Copper | 17 | 125,499,146 | W | 3,727,075 | [2]699,308 | W | -- |
| Lead | 1 | W | W | W | W | W | -- |
| Total | 18 | W | W | W | W | W | -- |
| Other lode material: |  |  |  |  |  |  |  |
| Gold-silver tailings | -- | W | W | W | W | W | -- |
| Silver tailings | -- | W | W | W | -- | -- | -- |
| Copper precipitates | 5 | 69,205 | -- | -- | 46,804 | -- | -- |
| Copper tailings | -- | W | -- | -- | W | -- | -- |
| Lead tailings | -- | W | W | W | W | W | -- |
| Total | 5 | W | W | W | W | W | -- |
| Grand total | 24 | [3]125,687,818 | [3]51,548 | [3]4,093,036 | [3]746,453 | W | -- |

W Withheld to avoid disclosing company proprietary data.

[1] Detail may not add to totals shown because some mines produce more than one class of material. Operations from which metals are recoverod only from tailings or precipitates are not counted as producing mines.

[2] Includes copper recoverod from precipitates of ore leached.

[3] Includes items indicated by symbol W.

**Table 9.—Arizona: Lode mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by type of material processed and method of recovery**

| Type of material processed and method of recovery | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|
| Cyanidation | W | W | -- | -- | -- |
| Acid leaching (vat, tank, heap) | -- | -- | [1]22,788 | -- | -- |
| Smelting of concentrates | W | W | [2]676,484 | W | -- |
| Total | [2] [3]49,178 | W | 699,272 | W | -- |
| Direct smelting of: | | | | | |
| Ore | W | 323,179 | W | W | -- |
| Precipitates | -- | -- | 46,804 | -- | -- |
| Tailings[4] | W | W | W | W | -- |
| Total | [3]2,370 | W | [3]47,182 | W | -- |
| Grand total | [3]51,548 | [3]4,093,036 | [3]746,453 | W | -- |

Withheld to avoid disclosing company proprietary data.

[1] Includes copper recovered by electrowinning process.

[2] Includes metal recovered from tailings.

[3] Includes items indicated by symbol W.

[4] Does not include metal recovered from tailings by concentration.

**Gold.**—Most gold output in the State was recovered as a byproduct of copper production, with eight large-scale operations producing more than 94% of the gold. The depressed metals industry led, in part, to an almost 17% decrease in the amount of gold produced; the fall in the price of gold from an average of $424 per troy ounce in 1983 to $360.66 in 1984 significantly contributed to the nearly 29% drop in the value of the metal produced. Gold operations, in descending order of output, included San Manuel, Morenci, New Cornelia, Ray, Copper Queen, Tyro, Ash Peak, Safford, Eisenhower, McFarland & Hullinger tailings dump, San Xavier, Diumich, Schuylkill, Red Cloud, and OK Joint Venture. The number of small operations (under 100,000 tons per year of material treated) reporting production increased from seven to nine in 1984. Phelps Dodge, Newmont, Kennecott, and Asarco were the major gold producing companies.

**Lead.**—Lead production and value increased substantially in 1984. Nearly two-thirds of Arizona's lead ores produced in 1984 were recovered as a byproduct of copper production. Arizona's lead ores are often found as an accessory mineral in the porphyry copper deposits; however, the economics of processing the material usually preclude its recovery. The rise in the average price of lead from $0.217 per pound in 1983 to $0.255 in 1984 contributed to a significant increase in the value of lead production. In 1984, Kennecott's Ray Mines Div. was the leading lead producer, followed by McFarland & Hullinger's tailings dump in Pinal County, Red Cloud Mills Ltd.'s Red Cloud Mine, OK Joint Venture's project in Yuma County, Phelps Dodge's Ash Peak Mine, Eisenhower Mining's Eisenhower Mine, and Asarco's Mission and San Xavier Mines.

**Molybdenum.**—Molybdenum was recoverod as a coproduct and/or byproduct of copper production in Arizona. Production increased 10.7% as five operations increased molybdenum output. Shipments of molybdenum concentrates increased a mere 0.3% and value declined about 5% as the average producers price per pound of molybdenum in technical-grade molybdic oxide dropped from about $3.65 in 1983 to about $3.53 in 1984. Molybdenum exports rose 61.38% in quantity when the number of companies exporting the concentrates increased from two in 1983 to four in 1984. Domestic shipments dropped from nine operations in 1983 to four in 1984, and quantity declined 7.24%. Inventories decreased from 6,143,132 pounds at the beginning of 1983 to 2,737,373 pounds at the beginning of 1984.

Leading producers and shippers of molybdenum concentrate included Sierrita, San Manuel, Bagdad, Morenci, Pinto Valley, New Cornelia, and Inspiration. The molybdenum circuits of Mineral Park, Mission, Ray Mines, and Silver Bell remained closed, and the Eisenhower circuit was shut down when the Twin Buttes operation closed. Twin Buttes and Cyprus Pima had no production, but continued shipping molybdenum concentrate from their remaining stockpiles. About 78% of Arizona's molybdenum concentrate shipments originated in Pima County.

**Rhenium.**—The rhenium compound ammonium perrhenate was recovered as a byproduct of roasting molybdenum concentrate at Duval's Sierrita Mine. Duval was the only domestic producer to recover the product in 1984 because of the relatively low price of rhenium. U.S. consumption, however, increased as the petroleum industry utilized a platinum-rhenium bimetallic reforming catalyst to produce low-lead and lead-free high-octane gasoline.

**Silver.**—Recovered principally as a byproduct of copper production, silver output declined, though not as dramatically as in 1983, because some important copper producers reduced output of copper and silver or ceased the silver recovery. Silver production decreased nearly 9% in quantity; its value, however, plunged more than 35% as the average price of the metal dropped from $11.44 per troy ounce in 1983 to $8.14 in 1984. Listed in descending order of output, the following operations recovered silver in Arizona: Sierrita, Morenci, Eisenhower, San Manuel, Ray, Reymert, Mission, Pinto Valley, New Cornelia, San Xavier, Silver Bell, Ash Peak, Sacaton, Copper Queen, Diumich, Tiger tailings, Red Cloud, Safford, Tyro, OK Joint Venture, Schuylkill, and Gold Hill. Of these, 11 large-scale mines produced more than 91%. Silver production was reported by 11 small mines; however, 5 small mines recovering silver in 1983 were shut down in 1984. Four small mines and one large-scale operation started silver production.

**Tin.**—Wilkins Exploration and Development Co. mined a small amount of tin at the Cheops Mine, Graham County. In descending order of output, Alaska, Colorado, and Arizona produced tin in 1984.

**Uranium-Vanadium.**—Arizona reported no vanadium production in 1984. The U.S. Department of Energy placed old inactive uranium-vanadium millsites at Monument Valley and Tuba City on a list of medium-priority sites for the cleanup of low-level radioactive contamination. Operated by Rare Metals Corp. of America from 1955 to 1962 and by El Paso Natural Gas from 1962 to 1966, cleanup of the Tuba City mill will begin in late 1986. In a related matter, a Federal judge ruled that industry and the State, not the Federal Government, were responsible for cancer deaths among the Navajo Indians mining uranium-vanadium in the 1950's and 1960's in the Four Corners area.

Energy Fuels Nuclear Inc. of Denver, CO, submitted a plan of operations for a proposed uranium mine 13 miles south of the Grand Canyon. Near Owl Tank along Forest Service Road 305, the projected operation would take 3 years to develop. About 200 tons per day of ore would be trucked 240 miles from the mine to the company's uranium-vanadium mill at Blanding, UT. Energy Fuels has an estimated 40,000 uranium claims on both sides of the Grand Canyon and has pioneered exploration of breccia pipes for uranium-rich deposits of copper and other minerals.

## NONMETALS

**Asbestos.**—Controversy continued over the Mountain View Mobile Home Estates that were built on an abandoned chrysotile asbestos millsite near Globe. One group claimed that the EPA delayed activating moneys authorized by the Environmental Response, Compensation, and Liability Act of 1980 (Superfund) for cleanup of the waste dump; another claimed tests on 632 county residents, including miners, mill workers, and others, have not revealed a case of mesothelioma, or lung cancer.[11] More than $2 million has been spent by the State to move residents from the area.

**Cement.**—Finished portland cement produced in Arizona increased more than 7%. The volume of finished portland cement sold rose about 5%, leveling off after the 26% gain achieved in 1983. Value of those sales, however, increased 18%, partly because of an increase in the average price of cement. Masonry cement production increased 14%, and sales increased nearly 11% in quantity and about 18% in value.

Arizona Portland Cement Co., a division of California Portland Cement Co., and the Phoenix Cement Co., a division of Gifford-Hill and Co., produced cement in Arizona. The Arizona Portland Cement plant at Rillito was a four-kiln, dry-process plant with 1.2 million metric tons per year of cement-grinding capacity and 1.1 million tons per year of clinker capacity. The Phoenix Cement plant at Clarkdale was a three-kiln, dry-preheater-process plant with 630,000 tons per year of cement-grinding capacity and 550,000 tons per year clinker capacity.[12] Both companies sold a general-purpose and moderate-heat gray portland cement and masonry cement; Phoenix Cement also marketed a portland pozzolan cement.

Raw materials consumed included limestone, clays, gypsum, fly ash, iron ore, pyrite mill scale, and other substances. At both plants, natural gas and a small amount of coal were used as fuel for kilns, and electrical energy was purchased for the facilities. Finished portland cement was shipped in bulk and by rail from the plant at Clarkdale to the terminal and was trucked in bulk from the terminal to the consumer and in bulk or container from the plant to the consumer. At Rillito, shipments were trucked from the plant in bulk or containers to the consumer.

**Clays.**—Arizona clay production dropped about 9%, however, the value of its output fell about 43%. Common clay production dipped slightly, yet its value increased 5.5%, while bentonite output fell 38% and its value nearly 68%. In descending order of tonnage, common clay producers included Phoenix Brick Yard's Pantano Pit in Pima County and Tolleson Pit in Maricopa County; Phoenix Cement's pit in Yavapai County; and Magma Copper's mine at Superior, Pinal County. Leading uses for common clay included face brick, portland cement, and common brick. A nonswelling bentonite was mined by Arizona Gypsum Corp. of Superior Companies at its Verde Pit in Yavapai County, Harshaw/Filtrol Partnership in Apache County, and United Catalysts Inc. at its Cheto No. 1 Pit in Apache County. Bentonite was used for filtering, clarifying, and decolorizing mineral and animal oils, for desiccants, and for animal feed. McKusick Mosaic Co. mined a swelling bentonite at its Weary Lode Mine, Gila County, for medical, pharmaceutical, and cosmetic purposes. The average unit value of clay and shale was $5.95 in 1984, compared with $9.43 in 1983.

**Gem Stones.**—Arizona led the Nation with 36% of gem stone production. Most important gem stones were turquoise, recovered at several copper mines, and peridot. Production of gem stones declined in 1984. Paulkerrite was identified as a new titanium phosphate mineral found near Hillside, Yavapai County. The mineral occurred as an alteration product of triplite and was named after a Columbia University professor.[13]

**Gypsum.**—Crude gypsum output dipped about 2% in quantity after more than a 51% increase in 1983; its value, however, rose nearly 21%. Calcined gypsum production increased 4% in quantity and value. National Gypsum Co. quarried and crushed crude gypsum at Feldman, near Winkelman, Pinal County, and calcined gypsum for manufacturing wallboard at its plant in Phoenix. Pinal Mammoth Gypsum Co. quarried gypsum for agricultural use at its Thunderbird Mine 6 miles north of Mammoth, Pinal County. Superior Companies quarried gypsum for use as a cement additive 4 miles southeast of Camp Verde, Yavapai County, and near Winkelman, Pinal County.

**Lime.**—Quicklime production declined about 6% in quantity and more than 3% in value as the copper industry, a major consumer of lime, failed to recover from depressed conditions in 1982 and 1983. Genstar Lime Co., Yavapai County, was the leading producer of lime used for cement, followed by Can-Am Corp. near Douglas, Cochise County, and Magma Copper at San Manuel, Pinal County, in manufacturing lime for the copper industry.

In Arizona, Genstar's weather-related kiln shutdowns increased fuel and maintenance costs; however, because its revenues and volumes rose, operating income was kept at approximately the same level as 1983.

**Perlite.**—Crude perlite production dipped slightly; however, quantity of sales remained the same as their dollar value rose about 9%. Of six States mining perlite, Arizona ranked third after New Mexico and California.

Harborlite Inc. mined perlite from open pit mines near Superior, Pinal County, sized the product at its plant 2 miles west of Superior, and shipped to markets in California, Michigan, and Wyoming. Sil-Flo Inc. mined perlite from an open pit 2 miles southwest of Superior, treated the material in its plant at Superior, and marketed the product in Illinois, Louisiana, Texas, and Wyoming. Perlite was used as a filtering aid in pharmaceuticals, chemicals, sugar, and beverages, and as an agriculture fertilizer carrier.

Therm O Rock Industries Inc. increased output of expanded perlite for plaster aggregate, insulation, and horticultural aggregate at Maricopa, Maricopa County.

**Pumice and Pumicite (Volcanic Ash).**—Gila Valley Block Co. continued to quarry pumice and volcanic ash 25 miles east of Safford, Graham County. Sales remained the same in volume; however, their total value increased 40%. The materials were used mainly for building and decorative block, followed by landscaping and insulation.

**Pyrites.**—Sales of pyrite by Magma Copper, Superior Div., from its Magma Mine, were sharply off in 1984.

**Salt.**—Southwest Salt Co. solution mined the Luke Salt deposit at Glendale, Maricopa County, and recovered the product in solar evaporation ponds. About 1,500 short tons of salt per acre of pond was harvested; peak production was in the hottest months, between May and September. Salt was marketed for agriculture, industrial uses, and water softeners. The caverns created by salt mining were leased for storing propane and butane.[14] Salt production declined; however, sales and value of sales increased.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production in 1984 gained about 31.2% in output and nearly 36% in value over 1983 levels. In Arizona, 92 producers shipped construction sand and gravel from 146 pits at 134 operations in the following counties, listed in descending order of tonnage produced: Maricopa, Pima, Yavapai, Coconino, Pinal, Cochise, Mohave, Navajo, Gila, Graham, and Santa Cruz. Maricopa, Pima, and Yuma Counties accounted for more than 82% of the construction sand and gravel sold or used in the State.

The leading construction sand and gravel producer in 1984 was Tanner Co., operating in Coconino, Maricopa, Pima, Pinal, Yavapai, and Yuma Counties, followed by CalMat Co. of Arizona, Maricopa County; and Union Rock and Materials Corp., Maricopa and Pima Counties.

Construction sand and gravel operators continued to have problems with their excavations. In one example, after residents in Cottonwood protested that excavations changed the Verde River course causing damage to trees and wildlife, Yavapai County supervisors and the State required Valley Concrete and Materials Inc. to submit a plan to stabilize a portion of the river. The State also complained of injury to the riverfront at Dead Horse Ranch State Park, one-half mile downstream from the sand and gravel operation.

Table 10.—Arizona: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 6,090 | $22,507 | $3.70 |
| Plaster and gunite sands | 643 | 3,613 | 5.62 |
| Concrete products | 467 | 1,649 | 3.53 |
| Asphaltic concrete | 3,179 | 11,737 | 3.69 |
| Road base and coverings[1] | 5,241 | 14,557 | 2.78 |
| Fill | 2,598 | 5,921 | 2.28 |
| Snow and ice control | 38 | 180 | 4.73 |
| Other[2] | 12,182 | 41,796 | 3.43 |
| Total[3] or average | 30,439 | 101,959 | 3.35 |

[1] Includes road and other stabilization (cement and lime).

[2] Includes other unspecified uses.

[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—Producers of industrial sand and gravel included Arizona Silica Sand Co., Apache County, and Little Hill Mines Inc., Pinal County. Arizona Silica sold the product for hydraulic fracturing in the petroleum industry, blasting, and filtration, and Little Hill sold the commodity for flux. Industrial sand and gravel operations each produced less than 50,000 short tons. The price of industrial sand and gravel in the State averaged $17.18 per ton in 1984.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Preliminary estimates indicated crushed stone production increased about 9% in quantity and about 13% in value.

Complaints arose as crushed rock operations adjacent to residential areas caused problems for rapidly expanding real estate developments. At Flagstaff, mining of a cinder cone led local residents to protest truck traffic at night and trenching next to property lines. Fearing the Buffalo Ridge area north of Phoenix would be flattened or sold to local developers, local property owners opposed a granite rock and gravel operation that had been mined since 1953.

*Dimension.*—Production of dimension stone fell more than one-half in quantity and also declined in value.

**Sulfuric Acid.**—Arizona ranked first in producing sulfuric acid recovered as a byproduct in copper smelters. The State's copper industry supplied almost 37% of the Nation's byproduct sulfuric acid. The total domestic supply of the acid increased 15% in 1984; however, output of the product in Arizona increased about 88% in quantity and 66% in value because of a change in technology that increased the amount of sulfuric acid produced and recovered in the smelting process. Sulfuric acid production in the State was 1,201,716 short tons valued at $14,412,000.

**Vermiculite (Exfoliated).**—W. R. Grace & Co. produced exfoliated vermiculite at its plant in Phoenix, Maricopa County; the raw vermiculite was shipped in from out of State. Sales increased in quantity and value in 1984. The product was marketed for use principally in fireproofing, concrete aggregates, and block insulation, followed by soil conditioning, horticultural applications, loose-fill insulation, and plastic aggregates.

**Zeolites.**—Union Carbide Corp. continued to mine the natural zeolite, chabazite, from its Bowie deposit in Graham County. The company stripped the overburden from two pits that were estimated to contain a combined reserve of 1,000 short tons of chabazite. A warehouse that had been leased from NRG Inc. was purchased for storing and drying the chabazite.[15]

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[1] State Mineral Officer, Bureau of Mines, Denver, CO.

[2] Niemuth, N. J. Exploration 1984; Arizona. Min. Eng., v. 37, No. 5, May 1985, pp. 402-403.

[3] Arizona Pay Dirt. Congress Gives Wilderness System Biggest Increase Since 1964. No. 546, Dec. 1984, pp. 8B-9B.

[4] Keith, S. B., D. E. Gest, E. DeWitt, N. W. Toll, and D. A. Everson. Metallic Mineral District and Production in Arizona. Arizona Bureau of Geology and Mineral Technology Bull. 194, 1983, 58 pp., map scale 1:1,000,000.

[5] Cyprus Minerals Co. Information Statement. May 30, 1985, pp. F23-F24.

[6] American Metal Market. Aug. 3, 1984 p. 2.

[7] Kerr, B. P. Pennzoil Co. Annual Meeting Proceedings. First Quarter Report. Mar. 31, 1985; Report of the Annual Meeting of Shareholders. Apr. 25, 1985, p. 12.

[8] Pennzoil Co. 1984 Annual Report, pp. 23-24.

[9] Savely, J. P. Designing a Final Wall Blast To Improve Stability. Paper presented at the 1984 Annual Meeting of the Arizona Conference of AIME, Tucson, AZ, Dec. 10, 1984, 32 pp.

[10] Newmont Mining Corp. 1984 Annual Report, 56 pp.

[11] Arizona Pay Dirt. Fuss Continues Over Globe Asbestos 'Contamination' Case. No. 543, Sept. 1984, pp. 28A, 30A.

[12] Smith, M. North American Cement. Ind. Miner. (London), No. 196, Jan. 1984, pp. 51-65.

[13] Peacor, D. R., P. J. Dunn, and W. B. Simmons. Paulkerrite; A New Titanium Phosphate From Arizona. The Mineralogical Record, v. 15, No. 5, Sept.-Oct. 1984, pp. 303-306.

[14] Arizona Pay Dirt. Southwest Salt Pioneered a New Resource. No. 536, Apr. 1984, pp. 3A-4A.

[15] Eyde, T. H. Zeolites. Min. Eng., v. 37, No. 5, May 1985, p. 489.

### Table 11.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Arizona Portland Coment Co.,[1] a division of California Portland Cement Ce., a subsidiary of CalMat Co. | Box 338<br>Rillito, AZ 85246 | Quarry and dry-process, 4-rotary-kiln plant. | Pima. |
| Phoenix Cement Co.,[2] a division of Gifford-Hill and Co. | 2505 West Beryl<br>Box 35395<br>Phoenix, AZ 85069 | Quarry and dry-process, 3-rotary-kiln plant. | Yavapai. |
| Cinder (volcanic): | | | |
| Flagstaff Cinder Sales Inc | Old Highway 66<br>Box 2796<br>Flagstaff, AZ 86003 | Quarry | Coconino. |
| Superlite Builders Supply, a subsidiary of U.S. Industries Inc. | 4150 West Turney<br>Box 23163<br>Phoenix, AZ 85063 | Open pit mine and crushing plant. | Do. |
| Clays: | | | |
| Harshaw/Filtrol Partnership, of Kaiser Aluminum & Chemical Corp. and Chevron Corp. | Box 155<br>Sanders, AZ 86512 | Open pit mine | Apache. |
| Phoenix Brick Yard | 1814 South 7th Ave.<br>Phoenix, AZ 85007 | do | Maricopa. |
| Copper: | | | |
| Amoco Minerals Co., a subsidiary of Standard Oil Co. (Indiana), Cyprus Mines Corp.: | | | |
| Cyprus Bagdad Copper Co.[3] | Box 245<br>Bagdad, AZ 86321 | Open pit mine, mill, dump leach, solvent extraction-electrowinning plant. | Yavapai. |
| Cyprus Johnson Copper Co | Drawer R<br>Benson, AZ 85602 | Open pit mine, heap leach, solvent extraction-electrowinning plant. | Cochise. |

See footnotes at end of table.

## Table 11.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Copper —Continued | | | |
| Anamax Mining Co., Twin Buttes Mine.[3] | Box 127<br>Sahuarita, AZ 85629 | Open pit and underground mines and mill. | Cochise. |
| ASARCO Incorporated: | | | |
| Hayden Unit | Box 98<br>Hayden, AZ 85235 | Smelter and acid plant | Gila. |
| Mission Unit[4,5,6] | Box 111<br>Sahuarita, AZ 85629 | Open pit mine and mill | Pima. |
| Sacaton Unit[4,5] | Box V<br>Casa Grande, AZ 85222 | do | Pinal. |
| San Xavier Unit[4,5,6] | Box 111<br>Sahuarita, AZ 85629 | Open pit mine | Pima. |
| Silver Bell Unit[4] | Silver Boll, AZ 85270 | Open pit mine, mill, leach dumps, precipitation plant. | Do. |
| Duval Corp., a subsidiary of Pennzoil Co.: | | | |
| Mineral Park Mine | Box 3009<br>Kingman, AZ 86401 | Open pit mine, mill, leach dumps, precipitation plant. | Mohave. |
| Sierrita Mine[3,4] | Box 125<br>Sahuarita, AZ 85629 | Open pit mines, mills, leach dumps, precipitation plant. | Pima. |
| Eisenhower Mining Co., Eisenhower (Palo Verde) Mine.[3,4,5,6] | Box 39<br>Sahuarita, AZ 85629 | Open pit mine | Do. |
| Inspiration Consolidated Copper Co.[3] | Box 4444<br>Claypool, AZ 85532 | Open pit mines, mill, dump leaching, solvent extraction plant, electrowinning-electrorefining tankhouse, custom smelter, sulfuric acid plant, continuous-cast-rod fabrication plant. | Gila. |
| Ox Hide Mine | Box 4444<br>Claypool, AZ 85532 | Open pit mine and heap leach. | Do. |
| Kennecott, a subsidiary of Standard Oil Co. of Ohio, Ray Mines Div.[4,5,6] | Box 9<br>Hayden, AZ 85235 | Open pit mine, leach dumps, precipitation, vat-leaching, solvent extraction-electrowinning plants, smelter. | Gila and Pinal. |
| Magma Copper Co., a subsidiary of Newmont Mining Corp.: | | | |
| San Manuel Div.[1,3,4,5] | Box M<br>San Manuel, AZ 85631 | Underground mine, mill, smelter, refinery, continuous-rod casting plant. | Pinal. |
| Noranda Lakeshore Mines Inc., a subsidiary of Noranda Mines Ltd. | Box C-6<br>Casa Grande, AZ 85222 | In situ mine and solvent extraction-electrowinning plant. | Do. |
| Phelps Dodge Corp.: | | | |
| Copper Queen Branch[4,5] | Highway 92<br>Bisbee, AZ 85603 | Underground mine, leach dumps, in-place leaching, precipitation plant. | Cochise. |
| Douglas Reduction Works | Drawer E<br>Douglas, AZ 85607 | Smelter | Do. |
| Morenci Branch[3,4,5] | Morenci, AZ 85540 | Open pit mines, mills, tailings leach plant, leach dumps, precipitation plant, smelter. | Greenlee. |
| New Cornelia Branch[3,4,5] | Drawer 9<br>Ajo, AZ 85321 | Open pit mine, mill, and smelter. | Pima. |
| Pinto Valley Copper Corp., a subsidiary of Newmont Mining Corp. | Box 100<br>Miami, AZ 85539 | Open pit mine, mill, leach dumps, in-place leaching, precipitation plants, solvent extraction-electrowinning plants. | Gila. |
| Gypsum: | | | |
| National Gypsum Co.: | | | |
| Gold Bond Building Products Div. | Box 20863<br>Phoenix, AZ 85036 | Plant | Maricopa. |
| Winkelman Gypsum Pit | Star Route, Box 3990<br>Winkelman, AZ 85292 | Open pit mine and crushing plant. | Pinal. |
| Pinal Mammoth Gypsum Co | Box 1208<br>Coolidge, AZ 85228 | Open pit mine | Do. |
| Superior Companies[7] | 2402 South 19th Ave.<br>Phoenix, AZ 85005 | Quarries and plant | Apache,<br>Pinal,<br>Yavapai. |
| Lime: | | | |
| Can-Am Corp., Paul Lime Div | Drawer T<br>Douglas, AZ 85607 | Quarry and 3 lime kilns | Cochise. |
| Genstar Lime Co., a division of Genstar Corp. | Box 197<br>Peach Springs, AZ 86434 | Quarries and plant | Yavapai. |
| Perlite: | | | |
| Harborlite Inc | Box 960<br>Superior, AZ 85273 | Open pit mine and plant | Pinal. |
| Sil-Flo Inc | Box 127<br>Superior, AZ 85273 | do | Do. |

See footnotes at end of table.

## Table 11.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Pumice: | | | |
| Gila Valley Block Co | Box 465<br>Safford, AZ 85546 | Open pit mine | Graham. |
| Salt: | | | |
| Southwest Salt Co | Box 1237<br>Litchfield Park, AZ 85340 | Solar evaporation of brine from wells. | Maricopa. |
| Sand and gravel: | | | |
| CalMat Co. of Arizona, a subsidiary of California Portland Cement Co., a subsidiary of CalMat Co. | Box 52012<br>Phoenix, AZ 85072 | Open pit mines and plants | Do. |
| Tanner Co., United Metro Div | 3640 South 19th Ave.<br>Box 20128<br>Phoenix, AZ 85036 | do | Coconino, Maricopa, Pima, Pinal, Yavapai, Yuma. |
| Union Rock and Materials Corp | 2800 South Central Ave.<br>Box 8007<br>Phoenix, AZ 85066 | do | Maricopa and Pima. |
| Stone: | | | |
| Andrada Marble Co | 4901 East Drexel Rd.<br>Tucson, AZ 85706 | Quarry | Pima. |
| Arizona Granite | 7401 West Villa Rita Dr.<br>Peoria AZ 85345 | do | Maricopa. |
| Madison Granite Supplies | 7050 Grand Ave.<br>Glendale, AZ 85301 | Quarry and plant | Do. |
| Red Mountain Mining Inc | 4250 North Bush Highway<br>Mesa, AZ 85205 | do | Do. |
| Dolomite: | | | |
| Robert E. McKee Inc | Box 107<br>Peach Springs, AZ 86434 | Quarry and crushing plant | Mohave. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co., Construction Products Div. | 4220 West Glenrosa<br>Phoenix, AZ 85019 | Plant | Maricopa. |

[1] Also lime.
[2] Also clays.
[3] Also molybdenum.
[4] Also silver.
[5] Also gold.
[6] Also lead.
[7] Also clays and limestone.

# The Mineral Industry of Arkansas

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arkansas Geological Commission for collecting information on all nonfuel minerals.**

By James R. Boyle[1] and William V. Bush[2]

The value of Arkansas' nonfuel mineral production in 1984 was $272.6 million, an increase of $26.2 million over that of 1983. The increase was the first since 1979 when Arkansas achieved its record high value output of over $300 million. The increase reversed a 4-year decline that in 1983 resulted in the lowest value of production since 1975. Output of most nonfuel minerals increased with bromine and lime being the exceptions. The leading nonmetallic commodities in terms of value were bromine, cement, crushed stone, and sand and gravel. The State was a major producer nationally of abrasives, bauxite, and bromine. Construction minerals—crushed stone and sand and gravel—also contributed significantly to the State's economy, serving both local and regional markets.

Arkansas ranked first nationally in output of bauxite, bromine, and special silica stone for natural abrasive applications (oilstones and whetstones). The State was one of three that produced tripoli. Despite its national importance with regard to several minerals, Arkansas ranked 27th in the Nation in value of nonfuel minerals produced.

**Table 1.—Nonfuel mineral production in Arkansas[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | 879 | $9,956 | 1,019 | $7,838 |
| Gem stones | NA | 200 | NA | 200 |
| Sand and gravel: | | | | |
| Construction thousand short tons | $^e$6,900 | $^e$19,600 | 8,334 | 23,786 |
| Industrial do. | 386 | 4,796 | 459 | 6,207 |
| Stone: | | | | |
| Crushed do. | 13,448 | 51,267 | $^e$15,200 | $^e$59,800 |
| Dimension do. | 9 | 573 | -- | -- |
| Talc do. | 7 | 66 | W | W |
| Combined value of abrasives, bauxite, bromine, cement, gypsum, lime, tripoli, vanadium (1984), and value indicated by symbol W | XX | 159,972 | XX | 174,797 |
| Total | XX | 246,430 | XX | 272,628 |

$^e$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Arkansas, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Ashley | $154 | (2) | |
| Baxter | (3) | $664 | Stone (crushed). |
| Benton | (3) | 996 | Do. |
| Boone | (3) | 524 | Do. |
| Bradley | 5 | (2) | |
| Calhoun | W | (2) | |
| Carroll | 127 | W | Stone (crushed). |
| Clark | W | W | Stone (crushed), clays. |
| Clay | 186 | (2) | |
| Cleburne | 1 | W | Stone (crushed). |
| Columbia | W | W | Bromine. |
| Conway | 1 | (2) | |
| Craighead | W | 64 | Clays. |
| Crawford | W | W | Stone (crushed), sand and gravel (construction). |
| Crittenden | W | W | Clays. |
| Cross | 261 | (2) | |
| Dallas | 24 | (2) | |
| Drew | 13 | (2) | |
| Faulkner | W | 439 | Stone (crushed). |
| Franklin | W | (2) | |
| Fulton | 44 | 83 | Stone (crushed). |
| Garland | 5,988 | W | Stone (crushed), abrasives. |
| Grant | 162 | (2) | |
| Greene | 283 | (2) | |
| Hempstead | W | W | Sand and gravel (industrial), clays. |
| Hot Spring | 3,859 | 1,611 | Stone (crushed), clays, abrasives. |
| Howard | W | W | Cement, gypsum, stone (crushed). |
| Independence | W | W | Stone (crushed), lime, stone (dimension). |
| Izard | W | W | Sand and gravel (industrial), stone (crushed). |
| Jefferson | W | (2) | |
| Johnson | W | W | Clays. |
| Lafayette | 180 | (2) | |
| Lawrence | W | 4,670 | Stone (crushed). |
| Lincoln | 169 | (2) | |
| Little River | W | W | Cement, stone (crushed). |
| Logan | (3) | 433 | Stone (dimension), stone (crushed). |
| Lonoke | (3) | (3) | |
| Madison | W | (2) | |
| Marion | 483 | (2) | |
| Miller | W | W | Sand and gravel (industrial), clays. |
| Mississippi | 20 | (2) | |
| Montgomery | W | W | Stone (crushed), clays. |
| Nevada | 33 | (2) | |
| Newton | 7 | W | Stone (crushed). |
| Ouachita | W | W | Clays. |
| Perry | 1 | 846 | Stone (crushed). |
| Pike | 1,481 | W | Gypsum. |
| Poinsett | W | (2) | |
| Polk | 16 | (2) | |
| Pope | (3) | 780 | Stone (crushed). |
| Pulaski | W | W | Stone (crushed), clays. |
| Randolph | 5 | 28 | Stone (crushed). |
| St. Francis | W | (2) | |
| Saline | 12,305 | W | Bauxite, lime, talc, stone (crushed). |
| Scott | 18 | (2) | |
| Searcy | (4) | (2) | |
| Sebastian | W | W | Stone (crushed), clays. |
| Sevier | 295 | W | Stone (crushed). |
| Stone | W | (2) | |
| Union | W | W | Bromine. |
| Van Buren | (3) | -- | |
| Washington | 1 | 737 | Stone (crushed). |
| White | 13 | 989 | Do. |
| Yell | W | (2) | |
| Undistributed[5] | 175,368 | 213,967 | |
| Sand and gravel (construction) | XX | [e]19,600 | |
| Stone: | | | |
| Crushed | [e]48,500 | XX | |
| Dimension | [r][e]574 | XX | |
| Total[6] | [r]250,572 | 246,430 | |

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[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Crushed and dimension stone was produced; data not available by county. Total State value is shown separately under "Stone."

[4] Less than 1/2 unit.

[5] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[6] Data do not add to totals shown because of independent rounding.

## Table 3.—Indicators of Arkansas business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 2,307 | 2,325 | 2,349 |
| Total civilian labor force | do | 1,025 | 1,028 | 1,045 |
| Unemployment | do | 100 | 104 | 93 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 5.9 | 5.3 | 5.6 |
| Metal mining[2] | do | .3 | .2 | NA |
| Nonmetallic minerals except fuels[2] | do | 1.3 | 1.2 | NA |
| Coal mining[2] | do | .1 | (3) | NA |
| Oil and gas extraction | do | 4.2 | 4.0 | 4.1 |
| Manufacturing total | do | 195.2 | 200.3 | 213.5 |
| Primary metal industries | do | 6.4 | 6.6 | 7.8 |
| Stone, clay, and glass products | do | 4.5 | 4.7 | 4.9 |
| Chemicals and allied products | do | 6.9 | 6.3 | 6.1 |
| Petroleum and coal products | do | 1.4 | 1.4 | 1.2 |
| Construction | do | 29.9 | 30.0 | 34.3 |
| Transportation and public utilities | do | 42.7 | 42.7 | 45.3 |
| Wholesale and retail trade | do | 158.2 | 163.0 | 173.5 |
| Finance, insurance, real estate | do | 32.4 | 34.1 | 35.8 |
| Services | do | 119.8 | 128.6 | 134.1 |
| Government and government enterprises | do | 136.0 | 137.3 | 140.4 |
| Total | do | 720.1 | 741.3 | 782.5 |
| Personal income: | | | | |
| Total | millions | $19,383 | $20,546 | $23,033 |
| Per capita | | $8,402 | $8,838 | $9,805 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.6 | 40.1 | 40.5 |
| Total average hourly earnings, production workers | | $6.69 | $7.05 | $7.31 |
| Earnings by industry: | | | | |
| Farm income | millions | $671 | $590 | $1,132 |
| Nonfarm | do | $12,314 | $13,411 | $14,836 |
| Mining total | do | $201 | $153 | $170 |
| Metal mining | do | $6 | $4 | $5 |
| Nonmetallic minerals except fuels | do | $23 | $22 | $25 |
| Coal mining | do | $3 | $1 | $2 |
| Oil and gas extraction | do | $169 | $126 | $139 |
| Manufacturing total | do | $3,448 | $3,785 | $4,232 |
| Primary metal industries | do | $154 | $169 | $219 |
| Stone, clay, and glass products | do | $87 | $97 | $108 |
| Chemicals and allied products | do | $191 | $185 | $180 |
| Petroleum and coal products | do | $44 | $49 | $44 |
| Construction | do | $663 | $700 | $807 |
| Transportation and public utilities | do | $1,125 | $1,221 | $1,325 |
| Wholesale and retail trade | do | $2,078 | $2,241 | $2,486 |
| Finance, insurance, real estate | do | $568 | $677 | $739 |
| Services | do | $2,062 | $2,327 | $2,549 |
| Government and government enterprises | do | $2,110 | $2,247 | $2,462 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 6,385 | 10,070 | 9,150 |
| Value of nonresidential construction | millions | $253.2 | $282.5 | $356.9 |
| Value of State road contract awards | do | $88.3 | $115.4 | $169.6 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 584 | 696 | 761 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $250.6 | $246.4 | $272.6 |
| Value per capita | | $108 | $106 | $116 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Less than 50 employees.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

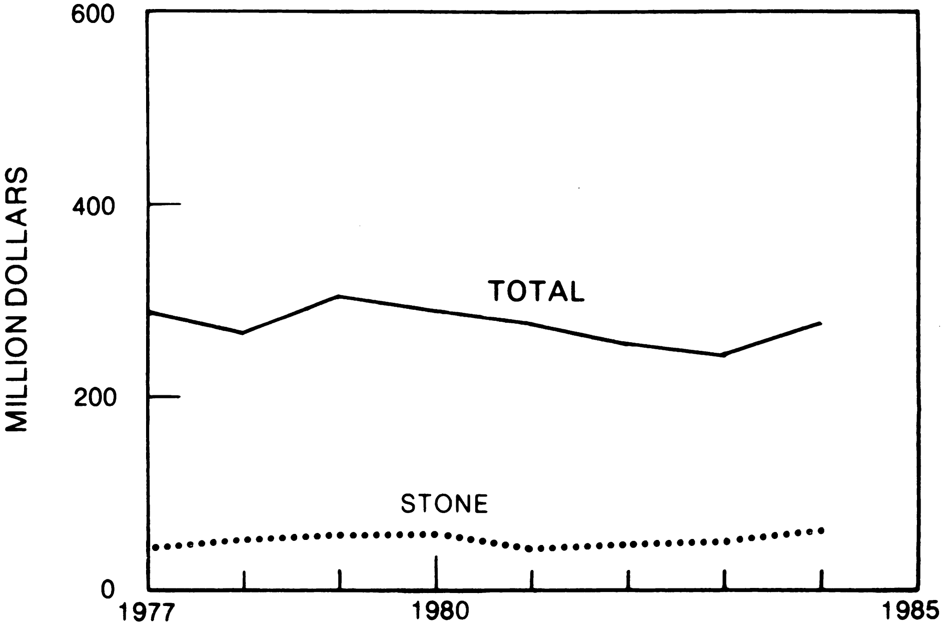

Figure 1.—Value of stone and total value of nonfuel mineral production in Arkansas.

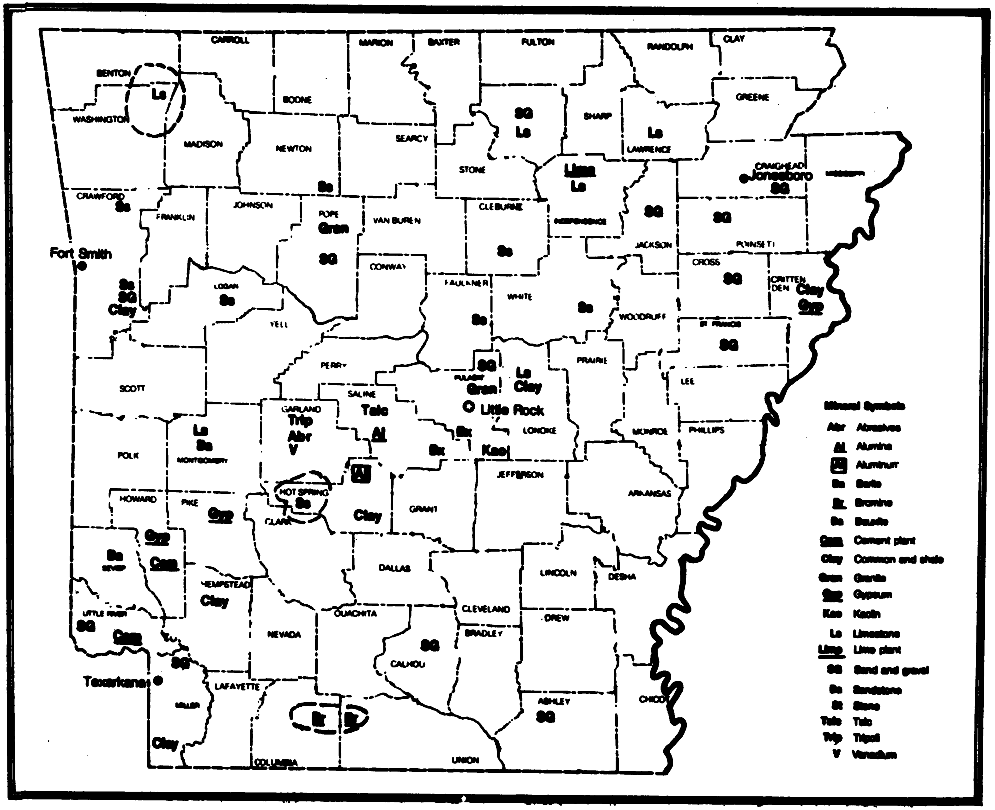

Figure 2.—Principal mineral producing localities in Arkansas.

**Trends and Developments.**—After a 4-year decline, output of minerals picked up during 1984. Increased orders were also noted at plants that manufacture valves and pipe fittings, predominantly foundry output. The recovery started late in 1983 and continued through most of 1984 with a downturn at yearend. Imports, along with the national recession, severely impacted on output of barite and vanadium, with no production of barite since 1982.

Foreign investment in Arkansas was limited in the mineral-related fields to agricultural chemicals (Federal Republic of Germany), aluminum extrusions and roofing products (France), and activated bauxite (Republic of South Africa).

The Arkansas State Chamber of Commerce reported that $992 million in investments for industrial growth was announced in 1984, down from $1 billion in 1983. The announced investments were expected to create an estimated 12,000 jobs, compared with 11,000 created in 1983. Of the total expansions, 11 were in mineral-related areas and totaled over $66 million.

Arkansas' exports totaled nearly $5 billion annually and were predominantly agriculture products. Notable mineral exports included quartz to Belgium, whetstones to Europe, and rice hull ash to the Federal Republic of Germany where, because of its high silica content, it was used in the manufacture of steel.

Total tonnage on the Arkansas River increased from 8 million short tons in 1983 to nearly 9.5 million tons in 1984. More commodities were shipped in 1984 than in any year since the record-high year of 1978, when 9.8 million tons was shipped. Outbound shipments were 45% of the total, while internal movements comprised 26%; inbound shipments, 22%; and shipments passing through the mouth of the system, 7%. Sand and gravel shipments increased 32% to 2.4 million tons, coal increased 28% to 1.3 million tons, chemical fertilizer increased 47% to 1 million tons, iron and steel increased 54% to 800,000 tons, and stone increased 69% to 177,000 tons.

The U.S. Army Corps of Engineers completed a $250 million project on the Ouachita River in southern Arkansas—two locks and dams along with a 9-foot channel connecting Camden to the Mississippi River. Anticipated mineral traffic includes bromine, sand and gravel, and stone.

**Employment.**—The unemployment rate dropped from 10.1% at yearend 1983 to below 8% in September, but ended 1984 at 9.2%. Employment levels in mineral-related industries reacted in a mirror image, with employment picking up at midyear and dropping late in the year. Construction employment peaked at midyear and remained at about the same level through the balance of 1984, indicating that demand for construction minerals remained firm throughout the latter part of the year.

According to the Arkansas Employment Security Division, the most significant increase during 1984 occurred in the metal products division where employment increased by 1,900 positions. Manufacturing employment increased over 13,000 but was still below the record high of 223,000 in mid-1978.

**Legislation and Government Programs.**—The Arkansas Legislature meets biennially with the next session scheduled to begin in January 1985. The first year of a 3-year phased-in increase in severance taxes on clays, sand and gravel, and stone went into effect in January 1984. The increase is 1 cent per ton per year; excluded was limestone used for agricultural purposes. Although the tax increased to 2 cents per ton in 1984, it did not appear to adversely affect output.

The Arkansas Department of Revenue received $23.8 million in severance taxes during fiscal year 1984. Severance taxes were received from oil ($22.5 million), brine ($442,000), natural gas ($384,000), sand and gravel ($325,000), bauxite ($135,000), coal ($5,700), and miscellaneous minerals ($24,400).

During the year, the legislative subcommittee on leasing State-owned lands expressed concern over the low royalty rate for older mineral leases. Older leases date to 1937 with royalty rates for sand and gravel of 2.5 to 5 cents per cubic yard with no termination date. Leases after 1981 were for specific periods with royalties ranging as high as 31.5 cents per cubic yard. Thirty-five permits were outstanding for sand and gravel covering 144 river miles of the Arkansas, Mississippi, Ouachita, and White Rivers. In August, the State Natural Resources Committee imposed a 5-mile limit on the length of river that could be covered by any one sand and gravel lease. Arkansas received $1,063,000 in royalties during fiscal year 1984 from mineral leases. Royalties were received from oil and gas ($760,000) and sand and gravel ($65,000) leases. The balance of $238,000 was bonus payments.

The Arkansas Geological Commission (AGC) continued its program that focused on the prudent development and use of the mineral, water, and energy resources of the State. Outside geologic interest centered on oil and gas, base metals, rare earths, lignite, and diamond exploration. Interest in oil and gas centered in the Ouachita Mountains where limited drilling occurred. AGC continued efforts on a series of oil and gas charts for the Lower Atoka Formation in the subsurface of the Arkansas Valley; to date, 8 of the scheduled 19 charts have been published. AGC has drilled over 1,500 test holes over the last several years in south and northeast Arkansas to determine the extent, characteristics, and quality of lignite. During the year, this work resulted in a lignite report, "Stratigraphic Framework and Distribution of Lignite on Crowley's Ridge, Arkansas." Assistance was also provided to individuals conducting exploration for rare earths in Saline and Hot Spring Counties, for silver and base metals in the Ouachitas, and for diamonds in the southwest part of the State. In cooperation with the U.S. Geological Survey (USGS), the AGC conducted a mineral appraisal in the northern part of Arkansas. Staff geologists also served as advisors in the review of mining reclamation and landfill permits. Two guidebooks were published in addition to "Contributions to the Geology of Arkansas, Volume II," which included articles relating to basement rock, north Arkansas stratigraphy, Ouachita Mountains stratigraphy, and other geologic topics.

Late in the year, the U.S. Bureau of Land Management (BLM) identified 75 parcels of land covering over 22,000 acres of unleased Federal land presumed to contain oil and gas resources. BLM proposed to publish a notice in 1985 detailing the location of these unleased parcels to determine priority of leasing.

The USGS continued several cooperative programs with the AGC concerning water and mineral resources in the State. The USGS published Professional Paper 1300, "Wilderness Mineral Potential." Included in the report were nine areas in Arkansas: five wilderness areas and four roadless areas. The publication was prepared in cooperation with the U.S. Bureau of Mines. Three other Roadless Area Review and Evaluation areas were under study. The USGS also published an open file report, OF 83-0846, "Proceedings of Conference XXIII, a Workshop on Continuing Actions To Reduce Potential Losses From Future Earthquakes in Arkansas and Nearby States." The U.S. Bureau of Mines Tuscaloosa Research Center, under an agreement with the Silica Products Co. Inc., Guion, provided technical assistance in dewatering a clay waste at the plant.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

Of the total value of nonfuel minerals in Arkansas in 1984, the major portion was attributed to nonmetals. Four of the eleven announced expansions in the minerals industry involved industrial minerals totaling over $40 million; commodities included bromine, clays, graphite, and vermiculite.

**Abrasives (Natural).**—During 1984, four companies mined novaculite for oilstone and whetstone products; mine production and value increased over that of 1983. Arkansas ranked first nationally in output of special silica stone abrasives. Finished stone production accounted for 83% of the total value and 21% of the total quantity of special silica stone products sold or used by domestic producers. Novaculite, a dense, hard, fine-grained metamorphosed chert of virtually pure silica, was mined in Garland County by Norton Co. Oilstones Inc. and Hiram A. Smith Whetstone Co. Inc. and in Hot Spring County by Arkansas Whetstone Co. Inc. and Wallis Whetstone Inc. Marvin Wright Whetstone Co. developed a deposit of novaculite in Garland County to market the crude stone. The company also started cutting and finishing whetstone and oilstones during the year at a plant in Hot Spring County. At all operations, output was relatively low with waste material ranging up to 95% of material mined. Some waste material was used in limited applications, with other markets being sought for the rejected material. Several firms only finished small quantities mined in Garland and Hot Spring Counties by other companies. These companies included Arkansas Oilstone Co., Hall's Arkansas Oilstones Inc., Pioneer Whetstone Co., Dan's Whetstone Co. Inc., and Washita Mountain Whetstone Co. Buffalo Stone Corp. shipped deburring media from Garland County.

**Barite.**—The Arkansas barite industry, severely affected by several factors, remained shut down in 1984. The last reported production was in 1982 when the State ranked third nationally in output. Milchem Inc.'s $40 million plant at Fancy Hill, completed in 1982, closed the same year. Milchem reportedly will not reopen the plant. Reasons cited for the basic shutdown of the industry were imports, reduced demand, high operating costs, and at Milchem's operation, environmental problems. Reportedly, ore from Nevada handled the limited demand that previously was filled by Arkansas barite.

**Bromine.**—Arkansas remained the largest domestic bromine producer and accounted for about one-half of the world's output in 1984. Production and value increased about 5% over that of 1983. Bromine occurs in salt brines in the south-central part of the State in Columbia and Union Counties. The highly capital-intensive industry, with an investment of over $300 million, reportedly has 85% of the Nation's capacity to produce bromine chemicals. Because of several adverse factors, which included imports and limited markets, the industry operated at slightly over 50% of capacity at times during 1984. Two companies, Dow Chemical U.S.A. and Ethyl Corp., operated in Columbia County, and two others, Arkansas Chemicals Inc. and Great Lakes Chemical Corp., operated in Union County.

Although operating below capacity, Dow and Ethyl expanded bromine derivative plant capacities during the year to meet future needs. New wells drilled during the year were basically replacement wells. Ethyl started up a 15-million-pound-per-year tetrabromobisphenol—a facility and a new plant to produce sodium bromide and calcium bromide powders. Dow announced plans to build a new calcium bromide plant and modernize its existing bromine plant after phasing out its Midland, MI, operations. Construction plans, which have been deferred since 1979, were scheduled to begin early in 1985 with completion scheduled for 1986. Total costs for the 120-million-pound-per-year plant and other modernizing plans will exceed $30 million. Brine requirements will come from wells in Columbia County and will be transported by existing pipeline. Bromine chemicals are used as gasoline additives, agricultural chemicals, flame retardants for plastics and textiles, pharmaceuticals, oil and gas well completion fluids, fire extinguishing agents, water sanitizers, catalysts, and other industrial chemical intermediates.

The bromine industry actively opposed a free trade area agreement with Israel that would include bromine chemicals. The producers consider bromine chemicals to be sensitive items of trade that should be excluded from any agreement. If included, the industry maintained that the agreement would cause severe economic consequences to the domestic bromine industry with the loss of one-third of the employees in the industry in Arkansas. Imports have tripled in the last 3 years, and the industry predicted that if the agreement includes bromine chemicals, imports would triple again by 1990.

**Cement.**—Portland cement shipments and value increased slightly over that of 1983. Masonry cement shipments decreased slightly while unit values increased over that of 1983. Two companies, Ideal Cement Co., a subsidiary of Ideal Basic Industries Inc., and Arkansas Cement Corp., a subsidiary of Arkla Inc., produced portland and masonry cement at plants in Saratoga and Foreman, respectively. Both plants, with a total of five kilns, used the wet process.

Major end uses for portland cement were ready-mixed concrete, concrete products, building materials, and highway construction. Raw materials used included chalk, gypsum, iron ore, limestone, and sand. Construction activities increased until midyear and remained constant for the balance of 1984. The Aluminum Co. of America (Alcoa) plant at Bauxite was one of three plants nationally that produced aluminous cement, a nonportland hydraulic cement.

Arkansas Cement continued its plant modification program. During the year, it awarded a contract to convert the largest of its three kilns from direct coal firing to indirect firing. Plans call for converting the plant from wet to dry process, incorporating two-stage preheaters with bypass systems on all three kilns. Also included will be a new raw material storage with blending and handling equipment.

Ideal curtailed operations in October, affecting 90 employees, with plans to resume normal production early in 1985.

**Clays.**—In 1984, Arkansas' clay industry produced common clay and kaolin with total output increasing over that of 1983. Production and value of common clay increased over that of 1983 while production and value of kaolin decreased 21% and 32%, respectively. Common clay was mined by 8 companies at 16 pits in 10 counties; leading counties were Crittenden, Hot

Spring, and Montgomery. Major uses were in brick and lightweight aggregate. Kaolin was mined by two companies at pits in Pulaski County. Arkansas ranked fourth in the Nation in output of kaolin. Output included unprocessed and calcined high-temperature kaolin. According to the Arkansas Chamber of Commerce, Acme Brick Co. invested over $60,000 for expansion at its Fort Smith plant.

**Gem Stones.**—Park authorities at the Crater of Diamonds Park in Pike County reported that 85,000 visitors had recovered 1,339 diamonds, compared with 1,501 diamonds in 1983. Total carat weight amounted to 202.26 carats; the largest diamond recovered was 5.58 carats. Of the recovered diamonds, 776 were white, 304 were brown, 241 were yellow, and 18 were uncommon—pink to light green; 14 exceeded 1 carat in weight. Other stones recovered in the State included agate, amethyst, barite, calcite, jasper, quartz, and other semiprecious gems.

Early in the year, Pike County residents approved a proposal to research the possibility of commercial diamond mining near the Crater of Diamonds. Five companies expressed interest in the project. No further actions were made during 1984.

**Graphite (Synthetic).**—Production and value increased 28% and 20%, respectively, over that of 1983, indicating a decrease in unit value. Arkansas ranked sixth in the Nation in the production of synthetic graphite. The electrodes produced were used in electric arc furnaces to melt scrap for production of steel. Great Lakes Carbon Corp. manufactured graphite at its plant in Ozark, Franklin County. Superior Graphite Co. acquired the graphite anode and electrode plant at Russellville from Dow Chemical Co.; the plant had closed in 1983. The plant has capacities of 3,000 short tons per year of graphite electrodes and 17,000 tons per year of extruded and baked carbon shapes. The plant will process silicon carbide made at Superior's Hopkinsville, KY, plant and will also utilize some of the enhanced carbons made at Hopkinsville. The Russellville plant was scheduled to be in operation late in the year.

**Gypsum.**—Output and value increased over that of 1983; output reached its highest level in 10 years. Crude gypsum was produced by Weyerhaeuser Co. in Howard County and Harrison Gypsum Co. Inc. in Pike County; Weyerhaeuser's Briar Mine and plant were 1 of the top 10 producing units in the Nation in 1984. Calcined gypsum was produced by Temple Eastex Inc., Crittenden County, and Weyerhaeuser, Howard County. Production increased while value decreased from that of 1983. During the year, Weyerhaeuser celebrated 3 million hours of operation without a lost-time accident at its Briar facilities. In the last 21 years, the operation has registered 11 accident-free years.

**Lime.**—Output and value of quicklime and hydrated lime decreased from that of 1983. Output of total lime was at its lowest level in over 15 years. Quicklime and hydrated lime were produced by Arkansas Lime Co., Independence County. Alcoa, which had produced quicklime, permanently closed in 1983.

**Nitrogen.**—Agrico Chemical Co., Blytheville, produced anhydrous ammonia during the year. The facility had a rated annual capacity of 407,000 short tons.

**Perlite (Expanded).**—Strong-Lite Products Corp. expanded perlite shipped in from out of State at its plant in Pine Bluff, Jefferson County. Output remained at the same level as that of 1983 while value increased 4% over that of 1983. Expanded perlite was used in concrete aggregates and horticultural applications.

**Quartz.**—Various grades of natural quartz were surface mined and processed by Coleman Crystal Inc. at Jessieville, and by Ocus Stanley and Burrow Mining Co. at Mount Ida. Coleman was the major domestic producer of lascas for electronics. Estimated production of lasca increased because of increased market demands. Geomex Mine Services Inc., which purchased the old Coleman Mine in 1983, constructed new processing facilities and went into full production by yearend. The Nos. 1 and 2 grades of quartz were primarily used in optics and electronics. Most of grades Nos. 3 and 4 were used as a medium to manufacture higher grade material. Geomex reported that production could reach 3.3 million pounds per year as demand increased. Much of the output was shipped to Japan and the Federal Republic of Germany.

**Sand and Gravel.**—Arkansas produced both construction and industrial sand and gravel in 1984. Production was from 61 companies producing from 78 pits in 40 counties. Total output increased over that of 1983, but was still well below the record-high output years of the 1970's.

*Construction.*—Construction sand and gravel production is surveyed by the U.S.

Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel was the fourth leading commodity in value among the nonfuel minerals produced in Arkansas. The increase in 1984 was basically due to a surge in construction activities that increased by midyear and maintained its momentum through yearend. Most operations were relatively small with no individual pit producing as much as 1 million short tons. Construction sand and gravel was produced at 68 operations in 38 counties. Leading counties were Little River, Ouachita, and Pulaski. Opposition to dredging sand and gravel from waterways continued through the year because of reported environmental problems. Major objections centered on loss of water quality, deleterious effect on fish, and loss of recreation utilization. These objections have been recognized and will be considered by the State in future leasing contracts.

**Table 4.—Arkansas: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 4,215 | $13,743 | $3.26 |
| Plaster and gunite sands | 126 | 301 | 2.38 |
| Concrete products | W | W | 2.55 |
| Asphaltic concrete | 164 | 384 | 2.34 |
| Road base and coverings | 678 | 1,189 | 1.75 |
| Fill | W | W | 1.84 |
| Other[1] | 3,151 | 8,170 | 2.59 |
| Total or average | 8,334 | [2]23,786 | 2.85 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes other unspecified uses and uses indicated by symbol W.

[2] Data do not add to total shown because of independent rounding.

*Industrial.*—Five companies produced industrial sand and gravel from five counties during 1984, with output and value increasing. Producers were Silica Products, Gifford-Hill & Co. Inc., Ideal Cement, Turner Trucking Co., and Arkhola Sand & Gravel Co. No one operation produced more than 500,000 tons. Major uses for industrial sand and gravel were blasting abrasives, foundry molds, and glassmaking. Most of the output was shipped by truck.

**Stone (Crushed).**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone ranked third in mineral value in Arkansas with output estimated to have increased over that of 1983. The estimated increase, however, did not reach the levels of output during the 1970's. Material mined included limestone, granite (syenite), sandstone, slate, and dolomite. Arkansas led the Nation in 1983 in output of crushed sandstone and was one of the top three States in crushed slate production. Leading counties in 1983 were Pulaski, Lawrence, and Independence. Crushed stone was used primarily in cement manufacture, ballast, and aggregate. Most companies increased output because of increased construction activities, but several operated intermittently because construction activities were out of their marketing areas.

**Sulfur (Recovered).**—Two companies recovered sulfur from their operations with output and value increasing over that of 1983, the third straight year of increased output. Phillips Petroleum Co., Lafayette County, recovered sulfur as a byproduct of petroleum refining at its McKamie plant, while Ethyl, Columbia County, recovered sulfur during bromine extraction at its Magnolia facility.

**Talc.**—The Milwhite Co. Inc. mined talc from its Congo Pit near Benton and processed the ore at its mill in Bryant. Reduced demand for roofing materials and as an industrial filler resulted in lower output from that of 1983 and well below the record-high output in 1982.

**Tripoli.**—Malvern Minerals Co. Inc., Garland County, remained the State's only producer of tripoli with output and value increasing over that of 1983. The company completed expansion plans at its plant early in the year. Output was used primarily as a filler with some used as an abrasive.

**Vermiculite (Exfoliated).**—Strong-Lite, Pine Bluff, and W. R. Grace & Co., North Little Rock, exfoliated crude vermiculite from out of State with output decreasing slightly from that of 1983; unit values increased. Crude vermiculite for Strong-Lite was imported from the Republic of South Africa. According to the Arkansas Chamber of Commerce, Strong-Lite started a $175,000 expansion program at its Pine Bluff plant. Exfoliated vermiculite was used for texturing paints and in aggregate, insulation, agriculture, and fireproofing.

## METALS

Primary metal production, although not a significant industry in the State, showed signs of expansion, which would contribute to the economic well-being of Arkansas. The metals industry depended mainly on out-of-State raw materials with limited input from sources in Arkansas. According to the Arkansas Chamber of Commerce, seven expansions with expenditures of about $26 million were announced in metals-related industries.

**Aluminum.**—Arkansas was 1 of 17 States with primary aluminum production facilities, ranking 10th nationally in output. Production and value increased over that of 1983. Reynolds Metals Co. operated the Jones Mill and the Arkadelphia facilities during the year. The Jones Mill started the year at full capacity but shut down two potlines in August and a third in November, reducing output to 40% of capacity. The shutdowns were attributed to rising inventories and high power costs. The Arkadelphia facility operated at 100% capacity on low-cost hydroelectric power. Reynolds' Hot Springs continuous rolling mill at yearend was at 75% of its 200,000-short-ton-per-year capacity. New computer models were being developed to increase productivity by 15%. The Malvern cable plant, closed since 1982, reopened early in the year and by yearend was operating at about 70% of its 30,000-ton-per-year capacity. The facility was able to reopen after Reynolds and the union reached an agreement on wages and benefits. Reynolds' Hurricane Creek alumina chemicals plant, closed since 1983, permanently closed late in the year. Reynolds wrote off $11.6 million for the permanent closure of the plant. Reynolds' alumina plant near Corpus Christi, TX, imported bauxite raw materials from Australia, Brazil, and Africa, in order of volume, and supplied alumina to the two Arkansas primary aluminum plants.

**Bauxite.**—Arkansas remained the leading State in output of bauxite with production and value increasing, stopping a downward trend that started in 1977. Despite the increase, output was still much lower than that of the 1970's. Production was from two operations in Saline County, Alcoa and American Cyanamid Co. Porocel Corp., Little Rock, produced activated bauxite from purchased ore. Alcoa, which mines bauxite for its alumina plant at Bauxite, operated at low levels of capacity. Although shipments by Alcoa increased 10% over that of 1983, the company had a loss of $4.8 million for 1984 compared with $2 million in 1983. Alcoa reduced employment levels from 1,678 in 1979 to 1,100 at the end of 1984. To become more competitive, Alcoa announced plans to begin mining higher grade ores, reduce spending for capital projects in 1985, and reduce personnel. The company dropped certain product lines currently being sold at prices less than in 1981. The plant produced various chemicals for use in refractories, ceramics, coatings, and other uses.

Norton and Alcoa's partnership in production of proppants (Norton-Alcoa Proppant Co.) resulted in startup of construction in June of a $50 million expansion of Norton's facilities at Fort Smith. Construction was scheduled for completion in July 1985 with an increase of output from 100 to 300 million pounds per year. Alcoa started supplying calcined bauxite to Norton early in the year. The proppants are used in hydraulic fracturing to stimulate flow rates of oil and gas from wells.

American Cyanamid operated the Quapaw Pit and was developing the Globe Pit. The company processed and partially calcined bauxite for the production of aluminum sulfate, which is used in the paper industry and for water treatment. Business remained firm through most of the year with reduced demand in the last 3 months of 1984.

**Iron and Steel.**—National Tube Co., Little Rock, formerly York-Hannover Seamless Tube Inc., announced plans to start construction of its 250,000-short-ton-per-year pipe minimill early in 1985. Formerly announced for Little Rock, the $300 million facility will be built in Pine Bluff. The plant was scheduled for completion in 27 months, or by mid-1988. The seamless tubing would be used by the oil and gas industry.

Western Tube & Conduit Corp., a subsidiary of Sumitomo Metal Industries Ltd., announced plans to build a $10 million welded tube mill in Little Rock. The 36,000-metric-ton-per-year plant was scheduled for completion by mid-1985. The mill will manufacture conduits for electric cable and wire.

Quanex Corp. resumed construction of its $98 million specialty bar mill at Fort Smith. Construction of the 280,000-ton-per-year facility started in 1981, was halted in 1983, and resumed early in 1984. Quanex shipped its first product from the new facility in November. The facility, with two 55-ton ultrahigh power electric furnaces and three rotary continuous casters, reportedly would be the largest producer of rotary cast steel in the Nation. Quanex planned to produce special bar quality seam-free carbon and alloy steel bars for the forging industry making automotive and machinery parts.

According to the "Arkansas Directory of Manufacturers," seven gray iron and three steel foundries were in operation in the State. Of the announced expansions in the metals products industry, three involved foundries with investments of nearly $8 million.

**Vanadium.**—Umetco Minerals Corp., a subsidiary of Union Carbide Corp., was Arkansas' sole vanadium producer. The mine and mill in Garland County, closed since June 1982, reopened in July 1984. The company was developing the Christie Pit, about 7 miles from the plant, with two smaller pits adjacent to the plant. The plant operated at capacity throughout the last half of the year with markets expected to hold firm through 1985. The facility produced vanadium pentoxide from the vanadiferous clays, which was converted to ferrovanadium at other locations. The chief market was in steel alloys, but increased imports have adversely impacted the domestic industry.

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] Geologist, Arkansas Geological Commission, Little Rock, AR.

**Table 5.—Principal producers**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Abrasives: | | | |
| Oilstones and whetstones: | | | |
| Smith Whetstone Inc | 1500 Sleepy Valley Rd.<br>Hot Springs, AR 71901 | Quarry | Garland. |
| Tripoli: | | | |
| Malvern Minerals Co. Inc | Box 1246<br>Hot Springs, AR 71901 | Mine | Do. |
| Bauxite: | | | |
| Aluminum Co. of America[1] | 1501 Alcoa Bldg.<br>Pittsburgh, PA 15219 | Mine and plant | Saline. |
| American Cyanamid Co | Berdan Ave.<br>Wayne, NJ 07470 | do | Do. |
| Bromine: | | | |
| Arkansas Chemicals Inc | Route 6, Box 98<br>El Dorado, AR 71730 | Brine wells and plant. | Union. |
| Dow Chemical U.S.A., Magnolia plant | 2030 Dow Center<br>Midland, MI 48640 | do | Columbia. |
| Ethyl Corp., Arkansas Div | Box 729<br>Magnolia, AR 71753 | do | Do. |
| Great Lakes Chemical Corp | Box 2200<br>West Lafayette, IN 47906 | do | Union. |
| Cement: | | | |
| Arkansas Cement Corp., a subsidiary of Arkla Inc.[1] | Box 130<br>Foreman, AR 71836 | Plant | Little River. |
| Ideal Cement Co., a subsidiary of Ideal Basic Industries Inc.[1] | Box 8789<br>Denver, CO 80201 | do | Howard. |
| Clays: | | | |
| Acme Brick Co., a division of Justin Industries Inc. | Box 425<br>Fort Worth, TX 76101 | Pits and plants | Hot Spring and Sebastian. |
| Arkansas Lightweight Aggregate Corp | El Dorado, AR 71730 | Pit and plant | Crittenden. |
| Eureka Brick & Tile Co | Box 379<br>Clarksville, AR 72830 | Mine | Johnson. |
| A. P. Green Refractories Co., a subsidiary of United States Gypsum Co. | Box 6057<br>Little Rock, AR 72216 | Pit and plant | Pulaski. |
| Gypsum: | | | |
| Harrison Gypsum Co. Inc | Box 336<br>Lindsay, OK 73052 | Mine | Pike. |
| Weyerhaeuser Co., Dierks Div | Route 4, Box 78<br>Nashville, AR 71852 | Mine and plant | Howard. |
| Lime: | | | |
| Arkansas Lime Co., a subsidiary of Rangaire Corp.[1] | Box 2356<br>Batesville, AR 72501 | Quarry and plant | Independence. |

See footnotes at end of table.

## Table 5.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Perlite (expanded): | | | |
| Strong-Lite Products Corp | Box 8029<br>Pine Bluff, AR 71611 | Plant | Jefferson. |
| Sand and gravel: | | | |
| Construction: | | | |
| Jeffrey Sand Co | Box 998<br>Fort Smith, AR 72901 | Pits and plants | Faulkner, Pulaski, Sebastian. |
| St. Francis Materials Co., a division of Ben M. Hogan Co. Inc. | Box 999<br>Forrest City, AR 72335 | do | Calhoun, Craighead, Poinsett, St. Francis. |
| Industrial: | | | |
| Gifford-Hill & Co. Inc.[2] | Box 6615<br>Shreveport, LA 71106 | Pits | Miller. |
| Silica Products Co. Inc | Box 248<br>Guion, AR 72540 | Pit | Izard. |
| Stone: | | | |
| Granite: | | | |
| Freshour Construction Co. Inc | Drawer AF<br>Cabot, AR 72023 | Quarry | Pulaski. |
| McGeorge Contracting Co. Inc | Box 7008<br>Pine Bluff, AR 71611 | Quarries | Do. |
| Minnesota Mining & Manufacturing Co. | 3M Center, 224-65 W<br>St. Paul, MN 55101 | Quarry | Do. |
| Limestone: | | | |
| McClinton-Anchor Co., a subsidiary of Ashland Oil Inc. | Box 1367<br>Fayetteville, AR 72701 | Quarries | Benton, Madison, Washington. |
| Midwest Lime Co | Box 2608<br>Batesville, AR 72501 | Quarry | Independence. |
| Sandstone: | | | |
| Arkhola Sand & Gravel Co.,[1] a subsidiary of Ashland Oil Inc. | Box 1627<br>Fort Smith, AR 72901 | Quarries | Crawford and Sebastian. |
| H M B Construction Co | Box 5606<br>Texarkana, TX 75501 | Quarry | Sevier. |
| Ben M. Hogan Co. Inc.[1] | Box 2860<br>Little Rock, AR 72203 | Quarries | White. |
| M & M Rock Co. Inc | Box 1190<br>Conway, AR 72032 | do | Faulkner, Perry, White. |
| Slate: | | | |
| Bird & Son Inc | Drawer 151<br>Glenwood, AR 71943 | Quarry | Montgomery. |
| Sulfur (recovered): | | | |
| Ethyl Corp., Arkansas Div | Box 729<br>Magnolia, AR 71753 | Sulfur recovered in bromine extraction. | Columbia. |
| Phillips Petroleum Co | 724 Adams Bldg.<br>Bartlesville, OK 74004 | Sulfur recovered as a byproduct of petroleum refining. | Lafayette. |
| Talc: | | | |
| The Milwhite Co. Inc | Box 15038<br>Houston, TX 77020 | Mine and plant | Saline. |
| Vanadium: | | | |
| Union Carbide Corp., Metals Div | Route 6, Box 943<br>Hot Springs, AR 71901 | Mine and mill | Garland. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 62 Whittemore Ave.<br>Cambridge, MA 02140 | Plant | Pulaski. |
| Strong-Lite Products Corp | Box 8029<br>Pine Bluff, AR 71611 | do | Jefferson. |

[1] Also produced limestone.
[2] Also produced construction sand and gravel in Ouachita County.

# The Mineral Industry of California

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the California Department of Conservation, Division of Mines and Geology, for collecting information on all nonfuel minerals.**

**By F. V. Carrillo,[1] J. F. Davis,[2] and M. A. Silva[3]**

California continued as the leading State in the Nation in the production of nonfuel minerals. Value for 1984 rose to $2.0 billion, a 12% increase from that reported in 1983. The increase in value was attributed to the continued gradual recovery in the construction industry and a generally rebounding economy in the State following the recession of 1982. Most industrial mineral operations were near capacity throughout most of the year, as output increased over that of 1983.

**Table 1.—Nonfuel mineral production in California[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Boron minerals ______ thousand short tons__ | 1,303 | $439,181 | 1,367 | $456,687 |
| Cement (portland)______ do____ | 7,567 | 420,949 | 8,715 | 520,026 |
| Clays[2] ______ do____ | 1,816 | 18,255 | 2,100 | 23,868 |
| Gem stones ______ | NA | 300 | NA | 500 |
| Gold (recoverable content of ores, etc.)______ troy ounces__ | 38,443 | 16,300 | 85,858 | 30,965 |
| Gypsum ______ thousand short tons__ | 1,213 | 10,668 | 1,382 | 12,443 |
| Lime ______ do____ | 358 | 22,994 | 406 | 26,827 |
| Peat ______ do____ | 13 | 612 | W | W |
| Pumice ______ do____ | 65 | 1,582 | 80 | 1,600 |
| Sand and gravel: | | | | |
| Construction ______ do____ | [e]91,000 | [e]308,700 | 102,420 | 360,427 |
| Industrial ______ do____ | 2,150 | 34,066 | 2,281 | 39,176 |
| Silver (recoverable content of ores, etc.)__ thousand troy ounces__ | 27 | 308 | W | W |
| Stone: | | | | |
| Crushed ______ thousand short tons__ | 35,582 | 146,289 | [e]38,600 | [e]158,000 |
| Dimension ______ do____ | 20 | 2,839 | [e]22 | [e]2,990 |
| Talc and pyrophyllite ______ do____ | 71 | 1,289 | 74 | 1,642 |
| Combined value of asbestos, calcium chloride, cement (masonry), clays (fire clay), copper, diatomite, feldspar, iron ore, lead, magnesium compounds, molybdenum (1984), perlite, potassium salts, rare-earth metal concentrate, salt, sodium carbonate, sodium sulfate, tungsten ore and concentrate, wollastonite, and values indicated by symbol W ______ | XX | [r]359,218 | XX | 368,294 |
| Total ______ | XX | [r]1,783,550 | XX | 2,003,445 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in California, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Alameda | W | W | Salt, stone (crushed), clays. |
| Amador | W | W | Sand (industrial), stone (crushed), clays. |
| Butte | $1,814 | (2) | |
| Calaveras | 28,447 | W | Asbestos, cement, talc, stone (crushed). |
| Colusa | 51 | (3) | Stone (crushed). |
| Contra Costa | 8,489 | $17,322 | Stone (crushed), sand (industrial), lime, clays. |
| Del Norte | W | 3 | Stone (crushed). |
| El Dorado | 112 | 1,370 | Do. |
| Fresno | 12,244 | 1,081 | Stone (dimension), gold, clays, silver, stone (crushed). |
| Glenn | W | W | Lime, stone (crushed). |
| Humboldt | 1,081 | 309 | Stone (crushed). |
| Imperial | W | 21,398 | Stone (crushed), gypsum, gold, lime. |
| Inyo | 25,076 | 31,854 | Boron minerals, tungsten, stone (crushed), perlite, talc, clays, pumice, copper, silver, gold, stone (dimension), lead. |
| Kern | 410,487 | 466,532 | Boron minerals, cement, stone (crushed), clays, gypsum, gold, stone (dimension), silver, copper, lead. |
| Kings | W | W | Gypsum. |
| Lake | 1,322 | 1,261 | Stone (crushed). |
| Lassen | W | W | Diatomite, stone (crushed). |
| Los Angeles | 54,405 | 8,198 | Stone (crushed), lime, stone (dimension), clays. |
| Madera | W | W | Tungsten, stone (dimension), pumice, stone (crushed). |
| Marin | W | W | Stone (crushed), clays. |
| Mariposa | W | 23 | Gold, stone (crushed), stone (dimension), copper, silver. |
| Mendocino | 964 | (2) | |
| Merced | 1,342 | (2) | |
| Modoc | W | 1,168 | Stone (crushed), peat. |
| Mono | 979 | 1,050 | Pumice, stone (crushed), clays, talc, gold, silver. |
| Monterey | 21,981 | W | Magnesium compounds, stone (crushed), lime, sand (industrial). |
| Napa | W | W | Stone (crushed), salt, stone (dimension). |
| Nevada | W | W | Clays, stone (crushed). |
| Orange | 14,926 | W | Sand (industrial), feldspar, clays, stone (crushed). |
| Placer | W | 674 | Clays, stone (dimension), stone (crushed). |
| Plumas | W | W | Stone (dimension), stone (crushed), gold. |
| Riverside | 93,143 | W | Cement, iron ore, stone (crushed), clays, wollastonite, gypsum, sand (industrial), stone (dimension). |
| Sacramento | W | W | Clays. |
| San Benito | W | W | Stone (crushed), asbestos, clays. |
| San Bernardino | 410,433 | 428,972 | Cement, sodium carbonate, boron minerals, rare-earth minerals, stone (crushed), sodium sulfate, potassium salts, gold, clays, salt, calcium chloride, lime, iron ore, feldspar, silver, talc, gypsum. |
| San Diego | 36,366 | 16,326 | Sand (industrial), stone (crushed), stone (dimension), feldspar, salt, magnesium compounds, gypsum, clays, tungsten. |
| San Joaquin | 8,582 | W | Lime, gold, peat, silver. |
| San Luis Obispo | W | W | Stone (crushed), gypsum, stone (dimension). |
| San Mateo | 19,830 | W | Magnesium compounds, salt, stone (crushed). |
| Santa Barbara | W | W | Diatomite, lime, stone (crushed), stone (dimension). |
| Santa Clara | W | W | Cement, stone (crushed). |
| Santa Cruz | 30,440 | W | Cement, stone (crushed), sand and gravel (industrial), clays, peat. |
| Shasta | 21,137 | W | Cement, stone (crushed), clays, copper. |
| Sierra | W | W | Gold. |
| Siskiyou | W | 848 | Stone (crushed), pumice. |
| Solano | 1,250 | W | Stone (crushed). |
| Sonoma | 7,483 | 3,595 | Do. |
| Stanislaus | 4,891 | W | Gold, clays, silver. |
| Sutter | W | W | Clays. |
| Tehama | 184 | 197 | Stone (crushed). |
| Trinity | W | 109 | Do. |
| Tulare | 3,271 | W | Do. |
| Tuolumne | W | W | Stone (crushed), lime. |
| Ventura | 16,417 | 6,647 | Sand (industrial), clays, stone (crushed), gypsum. |
| Yolo | W | W | Lime. |
| Yuba | 3,570 | W | Gold, clays, silver, stone (crushed). |
| Undistributed[4] | 262,994 | 465,920 | |
| Sand and gravel (construction) | XX | [e]308,700 | |
| Stone: | | | |
| Crushed | [e]105,400 | XX | |
| Dimension | [r] [e]2,727 | XX | |
| Total[5] | [r]1,611,846 | 1,783,550 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Less than 1/2 unit.

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

California was the sole producer of boron minerals and ranked first among the States in the production of asbestos, diatomite, rare-earth metal concentrate, construction sand and gravel, sodium compounds, and tungsten. It ranked second in the production of natural calcium chloride, portland cement, calcined gypsum, magnesium compounds, expanded perlite, sodium carbonate, pyrophyllite, and wollastonite.

Industrial minerals accounted for the bulk of California's nonfuel mineral production, comprising more than 90% of the State's mineral production value. Thirty mineral commodities, including seven metallic minerals, were produced in California in 1984.

### Table 3.—Indicators of California business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 24,697 | 25,186 | 25,622 |
| Total civilian labor force | do | 12,184 | 12,269 | 12,503 |
| Unemployment | do | 1,211 | 1,185 | 972 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 50.4 | 48.1 | 49.6 |
| Metal mining | do | 1.9 | 1.7 | 1.5 |
| Nonmetallic minerals except fuels | do | 6.6 | 6.3 | 6.6 |
| Oil and gas extraction[2] | do | 40.3 | 39.9 | NA |
| Manufacturing total | do | 1,945.4 | 1,936.5 | 2,047.0 |
| Primary metal industries | do | 47.6 | 43.5 | 42.0 |
| Stone, clay, and glass products | do | 50.4 | 48.7 | 51.1 |
| Chemicals and allied products | do | 64.5 | 62.4 | 64.2 |
| Petroleum and coal products | do | 31.7 | 31.0 | 30.0 |
| Construction | do | 349.0 | 369.3 | 442.8 |
| Transportation and public utilities | do | 542.8 | 536.9 | 548.9 |
| Wholesale and retail trade | do | 2,275.3 | 2,343.9 | 2,512.2 |
| Finance, insurance, real estate | do | 642.4 | 661.7 | 695.0 |
| Services | do | 2,269.9 | 2,345.1 | 2,527.9 |
| Government and government enterprises | do | 1,735.2 | 1,724.3 | 1,729.8 |
| Total[3] | do | 9,810.3 | 9,965.9 | 10,553.2 |
| Personal income: | | | | |
| Total | millions | $312,205 | $334,400 | $371,202 |
| Per capita | | $12,642 | $13,277 | $14,487 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 40.0 | 40.3 |
| Mining (nonmetallic minerals, except fuels) | | 39.5 | 40.7 | 43.0 |
| Total average hourly earnings, production workers | | $9.42 | $9.52 | $9.77 |
| Mining (nonmetallic minerals, except fuels) | | $12.93 | $13.75 | $14.35 |
| Earnings by industry: | | | | |
| Farm income | millions | $5,054 | $4,805 | $5,351 |
| Nonfarm | do | $215,701 | $233,367 | $260,188 |
| Mining total | do | $1,735 | $1,740 | $1,915 |
| Metal mining | do | W | $38 | $33 |
| Nonmetallic minerals except fuels | do | $168 | $188 | $218 |
| Oil and gas extraction | do | $1,551 | $1,514 | $1,664 |
| Manufacturing total | do | $49,276 | $52,772 | $58,470 |
| Primary metal industries | do | $1,394 | $1,328 | $1,361 |
| Stone, clay, and glass products | do | $1,240 | $1,296 | $1,462 |
| Chemicals and allied products | do | $1,635 | $1,733 | $1,877 |
| Petroleum and coal products | do | $1,481 | $1,576 | $1,620 |
| Construction | do | $11,168 | $11,486 | $13,678 |
| Transportation and public utilities | do | $16,069 | $17,155 | $18,373 |
| Wholesale and retail trade | do | $36,186 | $38,946 | $43,873 |
| Finance, insurance, real estate | do | $12,797 | $15,177 | $17,322 |
| Services | do | $48,189 | $53,487 | $60,755 |
| Government and government enterprises | do | $38,644 | $40,814 | $43,844 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 85,704 | 172,721 | 221,975 |
| Value of nonresidential construction | millions | $7,496.8 | $8,821.5 | $10,915.8 |
| Value of State road contract awards | do | $390.0 | $260.0 | $555.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 6,034 | 7,035 | 9,316 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $1,611.8 | $1,783.6 | $2,003.4 |
| Value per capita | | $65 | $71 | $78 |

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

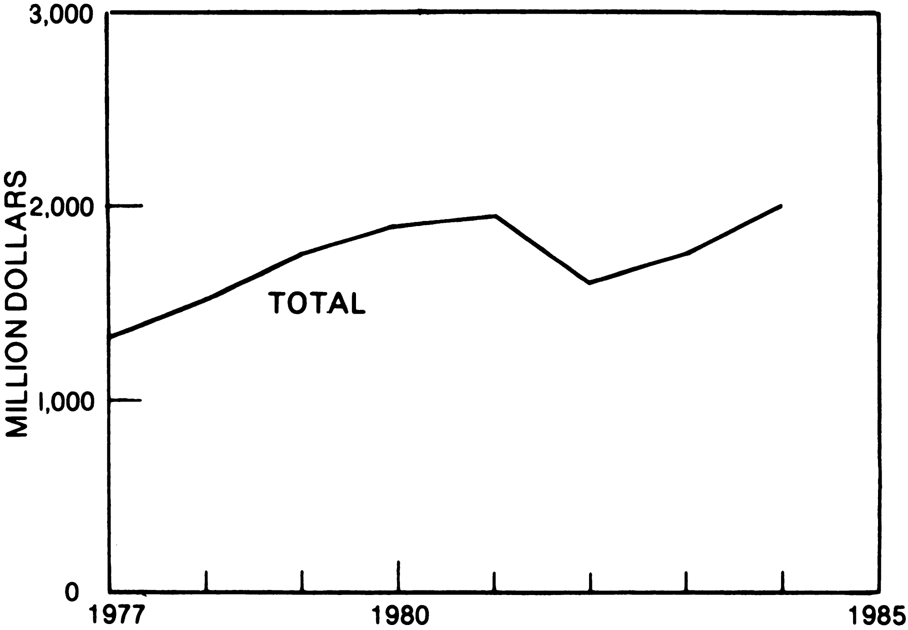

Figure 1.—Total value of nonfuel mineral production in California.

**Trends and Developments.**—A rising trend in mineral production and value was evident in 1984 as the State's economy improved. Exploration for and development of precious and strategic minerals continued throughout the year. At yearend, Homestake Mining Co.'s projected 200,000-ounce-per-year McLaughlin gold project in Napa County neared completion. Gold Fields Mining Corp. began full-scale construction in May on a 100,000-ounce-per-year heap leach carbon-in-pulp recovery plant at its Mesquite property in Imperial County.

There was extensive exploration activity during 1984—chiefly for gold. For further information, reference should be made to the "Gold" heading under the "Metals" section of this chapter.

The President signed a bill designating 1.8 million additional acres of land in California as "wilderness," essentially closing these areas to mineral exploration and production, and bringing the total amount of U.S. Forest Service-designated wilderness lands in California to 4 million acres.

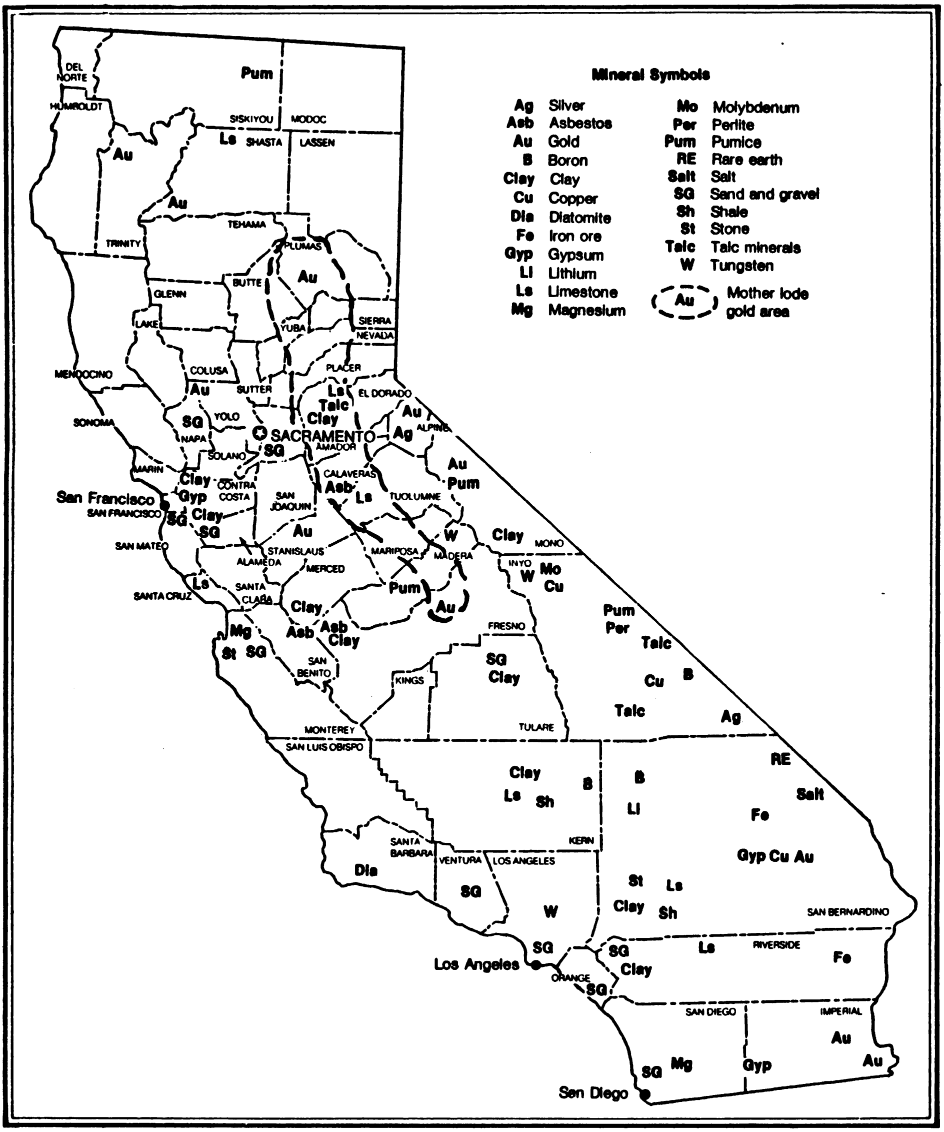

Figure 2.—Principal mineral producing localities in California.

**Legislation and Government Programs.**—The California State Mining and Geology Board assumed new responsibilities for developing guidelines and priorities for mineral resource conservation and mining under California's Surface Mining and Reclamation Act (SMARA). During 1984, the board continued work on the designation of aggregate resources in two major metropolitan areas and initiated the process in seven other regions.

Resource designations were completed for the western San Diego County region and the San Francisco-Monterey Bay areas. The board also decided to proceed with the designation of aggregate resources in these regions. Additional classifications were prepared for the nonurban program in the Sierra Nevada foothills and the California Desert Conservation Area (CDCA). During the year, the board accepted and formally transmitted classification reports for the Placerville, Georgetown, and Sutter Creek U.S. Geological Survey 15-minute quadrangle map sheets. The board also accepted and formally transmitted nonurban classification reports for three areas in the CDCA area—the Kelso, Mescal, and Halloran Springs 15-minute quadrangles.

SMARA was amended in the legislature by Assembly bill (AB) 1110 (AREIAS-Chapter 254, Statutes of 1984) to provide the means to identify areas where surface mining operations could pose potential threats to State highway bridges. AB 1110 allows the California Department of Transportation to provide early input to such proposed mining projects and to insert conditions in the permit language to mitigate potential detrimental impacts to State highway bridges.

The California Department of Conservation's Division of Mines and Geology continued work on mineral land classification studies. Nonurban studies were completed for the Folsom quadrangle in Sacramento, El Dorado, Placer, and Amador Counties, and for the Auburn quadrangle in El Dorado and Placer Counties. Mineral land classification studies (urban) were completed for the following aggregate-production consumption areas: Saugus-Newhall, Palmdale, Claremont-Upland, San Bernardino, South San Francisco Bay, and Monterey Bay.

Six mineral commodity reports were published, and occurrence and favorability maps for nine strategic minerals (at a scale of 1:1,000,000) were completed. Regional geologic mapping for the San Bernardino quadrangle was completed. Marine geology studies continued on a major synthesis of offshore California geologic mapping. Geothermal resource assessment studies, funded by the U.S. Department of Energy for geothermal resources in the vicinity of U.S. Naval facilities in the San Diego and Long Beach-Seal Beach areas, were completed.

The Mining and Mineral Resources and Research Institute at the University of California in Berkeley received a grant from the U.S. Bureau of Mines for operations and research, and the U.S. Bureau of Land Management distributed more than $35 million to California as its share of Federal mineral leasing receipts received during 1984.

Preliminary exploration continued in a section of the Pacific Ocean floor off the coast of northern California and southern Oregon. The Gorda Ridge Task Force, composed of officials from California, Oregon, and the Federal Government, met for the first time in December to coordinate research and exploration efforts to determine the extent and magnitude of mineral resources on the seamount crusts.

# REVIEW BY NONFUEL MINERAL COMMODITIES

## NONMETALS

**Asbestos.**—California again led the Nation in production of asbestos from mines in Calaveras and San Benito Counties. The Copperopolis Mine of Calaveras Asbestos Ltd. and Calidria Corp.'s Santa Rita Mine in San Benito County were the sole producers.

**Boron Minerals.**—California was the only domestic source of boron minerals, principally in the form of sodium borate. United States Borax & Chemical Corp., a subsidiary of RTZ Corp. in London, England, operated a mine and processing plant in Kern County that continued to supply the major portion of the State's domestic production. Kerr-McGee Chemical Corp. operated its Trona and Westend plants in San Bernardino County to produce a variety of borate products.

American Borate Co., a wholly owned subsidiary of Owens-Corning Fiberglas Corp., mined colemanite and ulexite-probertite at its mine in Death Valley National Monument. The colemanite product was trucked to Dunn for blending, storing, and shipping by rail to manufacturers of textile-grade glass fibers. Colemanite from this mine was ground and processed at the Walsh washing and calcining plant at Amargosa, NV (formerly Lathrop Wells). A flotation plant adjacent to existing facilities at Amargosa processed colemanite by a patented process.

Kerr-McGee operated the Trona and Westend plants at Searles Lake in San Bernardino County to produce refined sodium borate compounds and boric acid from lake brines.

U.S. Borax processed sodium borates and hydrous derivatives and hydrous boric acid at the boron refinery in Kern County. Crude sodium borate-rasorite 46, a pentahydrate, and its anhydrous derivative were produced for foreign markets. Installation of new equipment was completed to improve the recovery of borax.

**Calcium Chloride.**—Natural calcium chloride production was reported from three operations in San Bernardino County. Leslie Salt Co., a subsidiary of Cargill Inc., reported production from its Amboy plant; National Chloride Co. of America from its Bristol Lake plant; and Hill Bros. Chemical Co. from its Cadiz plant. Leslie Salt was the largest producer.

**Cement.**—California ranked second in the Nation, behind Texas, in the production of finished portland cement. Nearly all of the reported cement production in the State was of that variety. A production increase of about 16% from 1983 output was reported from 11 plants.

California Portland Cement Co., Los Angeles, merged with Conrock Co., a Los Angeles-based rock products and concrete company, to form CalMat Co. Work continued on CalMat's cogeneration project at its Colton plant, which is expected to cost $40 million and make the plant self-sufficient for electrical power.

Lone Star Industries Inc. acquired a 50% interest in Pacific Coast Cement Corp. of Long Beach.

Southwestern Portland Cement Co.'s new $100 million Victorville cement plant went into operation in the fall at a production rate of 2,650 short tons per day. Monolith Portland Cement Co. installed a new raw mill and blending and raw materials storage facility at its Glendale plant.

The San Andreas cement plant of Genstar Cement and Lime Co. remained closed throughout 1984. In late October, Genstar announced the purchase of the former Stinnes Cement Terminal at the Port of Stockton for approximately $7.5 million.

**Table 4.—California: Portland cement salient statistics**

(Short tons unless otherwise specified)

| | Northern California | | Southern California | | California total | |
|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| Number of active plants | 3 | 3 | 8 | 8 | 11 | 11 |
| Production | 2,123,611 | 2,518,081 | 5,386,466 | 6,204,049 | 7,510,077 | 8,722,130 |
| Shipments from mills: | | | | | | |
| Quantity | 2,280,755 | 2,507,005 | 5,285,972 | 6,208,306 | 7,566,727 | 8,715,311 |
| Value | $117,660,387 | $149,566,255 | $303,288,677 | $370,459,887 | $420,949,064 | $520,026,142 |
| Stocks at mills, Dec. 31 | 166,352 | 234,521 | 304,633 | 306,942 | 470,985 | 541,463 |

**Clays.**—Production of 2.1 million short tons of clay and shale in 1984 was reported from 34 companies in 22 counties throughout the State. Common clay and shale comprised the bulk of the clays produced with smaller amounts of kaolin, bentonite, fire clay, and ball clay.

The principal uses of clays produced were in construction materials, pet waste absorbents, sewer pipe, and paint.

Major producers of common clay and shale included Allied Chemical Co. in Amador County, Port Costa Materials Inc. in Contra Costa County, Excel Minerals Co. and General Portland Cement Inc. in Kern County, Lincoln Clay Products Co. in Placer County, Lone Star in Santa Cruz County, and Lightweight Processing Co. in Ventura County. The leading bentonite producer in California was Lowes Inc. of Kern County. Standard Industrial Minerals Co. was the leading producer of kaolin from mines in Inyo and Mono Counties. Fire clay was produced in Amador County and ball clay in Stanislaus County.

**Diatomite.**—California continued as the leading diatomite producer in the Nation. Principal producing companies were Grefco Inc. and Manville Products Corp. in Santa Barbara County and Lessenite Industries Inc. in Lassen County. The major producer was Manville Products from its operation near Lompoc.

American Resources Equity Corp. of Denver, CO, mined diatomite in Shasta County and shipped unprocessed material within the State for use as a silica source in making cement.

**Feldspar.**—The production of feldspar-silica mixtures was reported from Calspar Inc.'s San Bernardino plant, Crystal Silica Co.'s Oceanside plant in San Diego County, and the Owens-Illinois Inc. Mission Viejo plant in Orange County.

**Gypsum.**—California ranked second in the Nation in the production of calcined gypsum during 1984 and fifth in the production of crude gypsum.

Crude gypsum output was reported from Imperial, Kern, King, Riverside, San Bernardino, San Luis Obispo, and Ventura Counties. Calcined gypsum was produced in Alameda, Contra Costa, Imperial, and Los Angeles Counties. Byproduct gypsum was produced in Contra Costa, Fresno, and San Joaquin Counties.

**Lime.**—California ranked 12th among the 38 States and Puerto Rico reporting lime production in 1984. Output of 405,718 short tons was 13% more than that reported in 1983.

Kaiser Aluminum & Chemical Corp. sold its Natividad dolomitic lime and refractory dead-burned dolomite plant and facilities, in Monterey County, to the National Refractories & Minerals Corp. at yearend.

**Magnesium Compounds.**—Magnesium compounds were produced from hydrated dolomitic lime and sea water by Kaiser Aluminum in Monterey County. Dolomite from the Natividad quarry, 5 miles northeast of Salinas, was calcined to remove $CO_2$ and shipped to Moss Landing for processing with sea water for magnesia recovery.

Merck & Co. Inc. produced magnesium oxide, magnesium hydroxide, and magnesium carbonate at its San Mateo County plant. Western Magnesium Corp. produced magnesium chloride crystals at its San Diego County operation.

**Peat.**—Radel Inc. in Modoc County and Hyponex Corp. in Santa Cruz County were the only producers. Peat production was 15% less than that reported in 1983.

**Perlite.**—California ranked second in the United States in the production of both processed and expanded perlite. Perlite was mined at the American Perlite Co.'s mine, and expanded perlite was produced at seven active plants in Los Angeles, San Bernardino, and San Diego Counties. American Perlite's Redco mill in Los Angeles County was the largest producer.

**Potassium Salts.**—Kerr-McGee produced muriate of potash (60% $K_2O$) and sulfate of potash (50% $K_2O$) from plants in San Bernardino County.

**Pumice.**—California was the third largest domestic pumice producer in 1984. Siskiyou County was the leading producer of the five counties reporting pumice output. Processed pumice production was reported from Inyo, Madera, Mono, and Modoc Counties.

Tionesta Aggregates Co. and Featherock Inc. processed pumicite from operations near Tule Lake in Siskiyou County.

Principal uses were in abrasives, decorative building construction, and concrete aggregate, and as a pesticide carrier for crop dusting.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on estimates made before yearend.

California's 1984 output of construction sand and gravel increased more than 26% in quantity and 33% in value from that reported in 1982, again making it the leading producer among the States.

California Portland and Conrock, one of the Nation's leading construction sand and gravel producers, merged during the year to form a new company known as CalMat Co.

**Table 5.—California: Construction sand and gravel sold or used in 1984, by major use category**

| | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 33,872 | $126,088 | $3.72 |
| Plaster and gunite sands | 2,879 | 12,442 | 4.32 |
| Concrete products | 1,018 | 3,823 | 3.75 |
| Asphaltic concrete | 11,881 | 44,470 | 3.74 |
| Road base and coverings[1] | 15,758 | 52,440 | 3.33 |
| Fill | 6,318 | 17,932 | 2.84 |
| Snow and ice control | 200 | 334 | 1.67 |
| Railroad ballast | 83 | 331 | 3.99 |
| Other[2] | 30,410 | 102,569 | 3.37 |
| Total[3] or average | 102,420 | 360,427 | 3.52 |

[1] Includes road and other stabilization (cement and lime).
[2] Includes other unspecified uses.
[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—Industrial sand production of 2,281,331 short tons was reported from 10 operations in 8 counties. Three companies each produced more than 200,000 tons. Industrial sand was used primarily in glass containers, fiberglass, flat glass manufacture, and blasting. California ranked fourth nationally in 1984 in the production of industrial sand.

California Silica Products Co., a subsidiary of Ogleby Norton Co., acquired the Owens-Illinois Inc. silica sand operation near San Juan Capistrano, which produces mainly glassmaking sand. Yuba Natural Resources Inc. of Marysville formed a joint venture with Georgia Kaolin Co. of Elizabeth, NJ, to produce silica flour. The new company, Yuba Silica Inc., in Marysville, was expected to start producing in the first half of 1985.

**Sodium Compounds.**—California was the Nation's largest sodium sulfate producer in 1984 and the second largest sodium carbonate producer. All sodium sulfate production was from Kerr-McGee's Westend plant, where natural brines were pumped from Searles Lake. Sodium carbonate production was reported from Kerr-McGee's Argus and Westend plants in San Bernardino County. Lake Minerals Co. experimented with solar energy in refining trona aggregate from soda ash near the shores of Owens dry lake, Inyo County.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

California was among the top 10 producing States for crushed and broken stone in 1984. Production was estimated to be about 3 million short tons more than the reported 1983 production of 35,582,000 tons. In 1984, output of crushed stone was reported from 26 counties.

A new source of crushed stone was proposed for development in southern Alameda County by the Oliver de Silva Co. The East Bay Regional Park District gave tentative support by donating 320 acres of land to the project to develop 123 million tons of basalt on Apperson Ridge.

**Sulfur (Recovered).**—Byproduct sulfur was recovered at 15 oil refineries—4 in Contra Costa County, 9 in Los Angeles County, 1 in Santa Barbara County, and 1 in Solano County. California's 1984 production of more than 500,000 metric tons ranked fourth among the States for recovered elemental sulfur. Chevron U.S.A. Inc.'s refinery at El Segundo, Los Angeles County, was the largest producer.

**Talc and Pyrophyllite.**—California ranked sixth among the 11 producing States reporting talc and pyrophyllite production in 1984. Crude talc ore came principally from five operations in Inyo and San Bernardino Counties, with some production reported from one mine in Calaveras County. Processed talc production was reported from six operations in San Bernardino, Los Angeles, Inyo, Calaveras, and Sacramento Counties.

Pyrophyllite was produced and processed in Mono, San Bernardino, and Inyo Counties. North American Refractories Co.'s Victorville operations in San Bernardino County were idle during the year.

**Vermiculite (Exfoliated).**—California ranked first among the 29 States reporting exfoliated vermiculite production in 1984. W. R. Grace & Co. was the sole producer from plants in Newark (Alameda County) and Santa Ana (Orange County). Almost two-thirds of the vermiculite output was used in fireproofing.

**Wollastonite.**—California was the only State other than New York—the major producer—to report wollastonite production in 1984. Pfizer Inc. was the State's sole producer from an operation in Riverside County.

## METALS

**Copper.**—Over one-half of California's copper output was produced from copper precipitates of the Iron Mountain Mine in Shasta County. The remainder was recovered as a byproduct from gold, silver, or tungsten mining. Despite closure during much of the year, the Pine Creek Mine in Inyo County was the principal producer of byproduct copper from its tungsten operations. Five gold and silver mines in Inyo, Kern, and Shasta Counties also reported byproduct copper recovery.

**Gold.**—Nine lode mines, five placers, and one dredging operation reported gold production in California during 1984. Gold was also recovered from sand and gravel operations. Total gold recovery of more than 85,000 troy ounces was more than twice that of 1983. The Picacho Mine in Imperial County and the Grey Eagle Mine in Siskiyou County were the major lode producers. Significant amounts were also recovered from bucket-line dredging in Yuba County and from sand and gravel operations.

Site preparation and construction neared completion at Homestake's McLaughlin Mine in Napa County.

Gold Fields, a wholly owned subsidiary of Consolidated Gold Fields PLC, began construction of a large open pit heap leach gold mining operation at Mesquite, 35 miles east of Brawley, in Imperial County.

Chemgold Inc., the U.S. subsidiary of Glamis Gold Ltd., completed its second full year of production at the open pit Picacho Mine; the heap leach operation was reported by the company to be producing at a rate of about 2,000 ounces per month toward yearend.

Community opposition and lower gold prices forced Placer Services Corp. to postpone indefinitely its plans to open the San Juan Ridge gold property. In November, the voters of El Dorado County passed an initiative prohibiting mining within 10,000 feet of homes, schools, or businesses.

Placer Services continued to operate the Yuba 21 bucket-line dredge near Hammonton in Yuba County. Modification was begun of a larger dredge, the Yuba 17.

Development continued at Golden Bell Resources Inc.'s Pine Tree project in southern Mariposa County. Inca Resources completed hydrological work, engineering, and feasibility studies at its Rich Gulch property in Plumas County. NERCO Minerals Co., a subsidiary of Pacific Corp. of Portland, OR, signed an agreement with Mother Lode Gold Mines Consolidated to do exploratory drilling at the latter's Mountain King-Royal Mine in Calaveras County. Amselco Minerals Inc., a subsidiary of British Petroleum Corp. Ltd., started a major exploration program on Beaver Resources' Kramer Hills property in San Bernardino County. Cous Creek Copper Mines Ltd. began preliminary exploration at its Shoshone Mine's unit in Inyo County. Northcal Resources explored its Gold Cliff property near Angel's Camp in Calaveras County. Sunshine Mining Co. continued exploration at its Bellevue gold property, an underground placer gold mine in Plumas and Sierra Counties.

Additional exploration and development was reported in Calaveras, Mariposa, El Dorado, Sierra, Siskiyou, and San Bernardino Counties, and the Brush Creek Mining & Development Corp. mined 1,275 short tons of ore during the year at the Brush Creek Mine in Sierra County.

## Table 6.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

| | Mines producing[1] | | Material sold or treated[2] (metric tons) | Gold | | Silver | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Troy ounces | Value | Troy ounces | Value |
| 1982, total | 11 | 6 | 35,791 | 10,547 | $3,964,725 | 34,048 | $270,683 |
| 1983, total | 9 | 4 | [r]510,066 | 38,443 | 16,299,832 | 26,899 | 307,725 |
| 1984: | | | | | | | |
| Mono | 1 | -- | 2,431 | 278 | 100,263 | 5,261 | 42,828 |
| Shasta | -- | -- | 204 | -- | -- | -- | -- |
| Siskiyou | 1 | 2 | W | W | W | 87,915 | 715,686 |
| Other[3] | 7 | 3 | W | W | W | W | W |
| Total | 9 | 5 | W | [4]85,858 | [4]30,965,375 | W | W |

| | Copper | | Lead | | Total value |
|---|---|---|---|---|---|
| | Metric tons | Value | Metric tons | Value | |
| 1982, total | W | W | W | W | $4,433,070 |
| 1983, total | W | W | W | W | 16,840,551 |
| 1983: | | | | | |
| Mono | -- | -- | -- | -- | 143,091 |
| Shasta | 65 | 96,270 | -- | -- | 96,270 |
| Siskiyou | -- | -- | -- | -- | W |
| Other[3] | W | W | W | W | W |
| Total | W | W | W | W | W |

[r] Revised. W Withheld to avoid disclosing company proprietary data.

[1] Operations from which gold and silver are recovered as byproducts from sand and gravel operations and operations from which silver and copper are recovered as byproducts of tungsten ore are not counted as producing mines.

[2] Does not include gravel washed.

[3] Includes the following counties which are not listed to avoid disclosing proprietary data: Del Norte, Fresno, Imperial, Inyo, Kern, San Joaquin, Sierra, Stanislaus, and Yuba.

[4] Includes items indicated by symbol W.

**Iron Ore.**—Production of crude iron ore continued to decline in the State; output was limited to small amounts of ore from the Baxter and Beck Mines in San Bernardino County. Kaiser Steel Corp. shipped concentrates and agglomerates from its Eagle Mountain plant in Riverside County.

**Iron and Steel.**—California Steel Industries reopened the hot-strip mill and pickling lines at the former Kaiser Steel slab steel plant in Fontana. The idled Kaiser Steel mill at Fontana was purchased in August by California Steel and was reopened in September after a 10-month shutdown. Kaiser Steel's Eagle Mountain Mine, a producer of iron ore, was retained by Kaiser Steel and remained idle.

**Lead.**—Only a small amount of lead production was reported in the State during 1984. Lead was recovered as a byproduct from gold and silver production in Kern County.

**Molybdenum.**—All of California's 1984 molybdenum production was a byproduct from tungsten recovery at Umetco Minerals Corp.'s Pine Creek Mine in Inyo County. Umetco is a newly formed subsidiary of Union Carbide Corp.

**Nickel.**—Activity at California Nickel Corp.'s Gasquet Mountain nickel-cobalt property in Del Norte County was limited to assessment work and technical data collection for environmental studies.

**Rare-Earth Metal Concentrate.**—The 1984 output of rare-earth metal concentrate in California was 51% higher than that of 1983. Molycorp Inc.'s Mountain Pass operation in San Bernardino County produced about 50% of the world's rare-earth oxide production. The major use was as a catalyst for petroleum cracking plants. Other uses included iron and steel additives, ceramics, metal, glass, and electronics.

**Silver.**—The value of California's 1984 silver production more than doubled that of 1983. The quantity produced more than tripled, principally owing to increased production from lode gold and silver mines in Siskiyou, Mono, and Imperial Counties. Lode production of silver was also reported from Inyo and Kern Counties. Small amounts of placer silver production were reported from Fresno, San Joaquin, Siskiyou, and Stanislaus Counties, and from bucket-dredge operations in Yuba County.

**Tungsten Ore and Concentrate.**—California ranked first among the four States reporting tungsten production. Nearly all of the reported production in the United States in 1984 was from California.

Tungsten ore production was reported from five mines in Inyo, Kern, Los Angeles, and Madera Counties. Despite shutdowns, Union Carbide remained the leading producer of crude ore and concentrates from its Umetco Pine Creek Mine in Inyo County. Teledyne Tungsten's Strawberry Mine in Madera County was the second largest producer. Umetco's Pine Creek Mine and mill operated intermittently in 1984. The mine closed in October 1983, and the mill closed in March 1984. Beth the mine and mill reopened late in the year, with 113 workers recalled. Restrictions on access limited 1984 production at the Curtis Tungsten Co.'s Androw Mine to about 20,000 pounds of concentrate. Production was also reported from the Blue May and Truckee Queen Mines in Kern County.

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[1] State Mineral Officer, Bureau of Mines, Reno, NV.
[2] State geologist, California Department of Conservation, Division of Mines and Geology, Sacramento, CA.
[3] Geologist, California Department of Conservation, Division of Mines and Geology, Sacramento, CA.

### Table 7.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Asbestos: | | | |
| Calaveras Asbestos Ltd | Box 127<br>Copperopolis, CA 95228 | Surface mine and plant. | Calaveras. |
| Calidria Corp | Box K<br>King City, CA 93930 | do | San Benito. |
| Boron minerals: | | | |
| Kerr-McGee Chemical Corp.[1] | Kerr-McGee Center<br>Oklahoma City, OK 73125 | Evaporators and plant. | San Bernardino. |
| United States Borax & Chemical Corp. | Box 75128<br>Sanford Station<br>Los Angeles, CA 90010 | Surface mine and plant. | Kern. |
| Calcium chloride: | | | |
| Leslie Salt Co.,[2] a subsidiary of Cargill Inc. | 7200 Central Ave.<br>Newark, CA 94560 | Solar evaporators | San Bernardino. |
| National Chloride Co. of America[2] | Box 604<br>Norwalk, CA 90650 | do | Do. |
| Cement: | | | |
| California Portland Cement Div., CalMat Co.[3] | 9300 Flair Dr.<br>El Monte, CA 91731 | Plants | Various. |
| Kaiser Cement Corp | 300 Lakeside Dr.<br>Oakland, CA 94612 | do | Do. |
| Southwestern Portland Cement Co.[4] | Box 937<br>Victorville, CA 92392 | Plant | San Bernardino. |
| Clays: | | | |
| Excel Minerals Co | Box 878<br>111 South La Patera Lane<br>Goleta, CA 93116 | Pits | Kern. |
| Gifford-Hill & Co. Inc., Phoenix Cement Co.[5] | Box 47127<br>Dallas, TX 75241 | do | Various. |
| Lightweight Processing Co | 715 North Central Ave.<br>Suite 321<br>Glendale, CA 91203 | do | Ventura. |
| Lincoln Clay Products Co | Box 367<br>Lincoln, CA 95648 | Pit | Placer. |
| Lone Star Industries Inc.[6] | 2800 Campus Dr.<br>San Mateo, CA 94403 | Pit | Santa Cruz. |
| Port Costa Materials Inc | Box 5<br>Port Costa, CA 94569 | Pit | Contra Costa. |
| Diatomite: | | | |
| Manville Products Corp | 2500 Miguelito Rd.<br>Lompoc, CA 93436 | Surface mine and plant. | Santa Barbara. |
| Feldspar: | | | |
| California Silica Products Co | Box 249<br>31302 Ortega Highway<br>San Juan Capistrano, CA 92693 | Surface mine | Orange. |
| Crystal Silica Co | 3231 Oceanside Dr.<br>Oceanside, CA 92054 | Mine and plant | San Diego. |
| Gold: | | | |
| Chemgold Inc.[7] | Box 2015<br>Yuma, AZ 85364 | Mine | Imperial. |
| Noranda Exploration Inc.[7] | Box 788<br>Happy Camp, CA 96039 | do | Siskiyou. |
| Lime: | | | |
| Kaiser Aluminum & Chemical Corp.[8] | Box 1938<br>Salinas, CA 93901 | Surface mine and plant. | Monterey. |

See footnotes at end of table.

Table 7.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Perlite: | | | |
| American Perlite Co | 11831 Vose St.<br>North Hollywood, CA 91605 | Surface mine and mill. | Los Angeles. |
| Pumice: | | | |
| American Pumice Products Inc | 17992 Mitchell, South<br>Irvine, CA 92714 | do | Inyo. |
| Tionesta Aggregates Co | 13290 Hodge Dr.<br>Reno, NV 89511 | Surface mine | Siskiyou. |
| Rare earths: | | | |
| Molycorp Inc | Union Oil Center<br>461 South Boylston St.<br>Los Angeles, CA 91017 | do | San Bernardino. |
| Sand and gravel (construction): | | | |
| CalMat Co | Box 2950 Terminal Annex<br>Los Angeles, CA 90051 | Pits | Various. |
| Koppers Co. Inc., Kaiser Sand & Gravel Co. | Box 500<br>Pleasanton, CA 94566 | do | Do. |
| Livingston-Graham | 16080 East Arrow Highway<br>Irwindale, CA 91706 | do | Do. |
| Owl Rock Products Co | Box 330<br>Arcadia, CA 91006 | do | Do. |
| Pleasanton Gravel Co | Box 850<br>Pleasanton, CA 94566 | Pit | Alameda. |
| A. Teichert & Sons Inc., Teichert Aggregates. | 3500 American River Dr.<br>Sacramento, CA 95813 | Pits | Various. |
| Talc and pyrophyllite: | | | |
| Pfizer Inc.[9] | Drawer AD<br>Victorville, CA 92394 | Surface mines and plant. | Inyo. |
| Western Source Inc | Box 280<br>San Andreas, CA 95249 | Surface mine and mill. | Calaveras. |
| Tungsten ore and concentrate: | | | |
| Teledyne Tungsten | 4709 North El Capitan Ave.<br>Suite 109<br>Fresno, CA 93711 | Underground mine and mill. | Madera. |
| Umetco Minerals Corp.,[10] a subsidiary of Union Carbide Corp. | Route 2<br>Bishop, CA 93514 | Underground mine, mill, chemical plant. | Inyo. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 1114 Avenue of the Americas<br>New York, NY 10036 | Plants | Alameda and Orange. |

[1] Also lime, potassium salts, sodium carbonate, and sodium sulfate.
[2] Also salt.
[3] Also clays, gypsum, and iron ore.
[4] Also clays.
[5] Also cement and industrial sand.
[6] Also industrial sand.
[7] Also silver.
[8] Also magnesium compounds.
[9] Also clays and wollastonite.
[10] Also copper and molybdenum.

# The Mineral Industry of Colorado

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Colorado Geological Survey for collecting information on all nonfuel minerals.**

**By Karl E. Starch[1] and Patricia La Tour[2]**

The value of nonfuel minerals produced in Colorado in 1984 was $436.1 million. The 29% increase over that of 1983 reversed a 3-year decline in nonfuel mineral production in the State and was about equal in value to the 1976 level of output. The major factor in the increase was the return to production of the Climax and Henderson molybdenum mines in early 1984. An improvement in construction and the consequent surge in cement output accounted for most of the rest of the increase.

The State ranked 20th among all States in nonfuel mineral production, compared with 22d in 1983 and 7th in 1981. In 1984, 21 nonfuel minerals were produced in the State, 11 nonmetals and 10 metals. Nonmetals were responsible for 52% of the total, and metals, 48%. Cement contributed nearly one-half of the nonmetallic value and, with sand and gravel and stone, added to well over 90% of the total. Molybdenum provided well over one-half of the metals value and, adding the value of the base and precious metals (gold, silver, copper, lead, and zinc), accounted for more than 90% of total value. Vanadium made up most of the balance. The upturn in output was widely shared among the mineral commodities produced in the State.

**Table 1.—Nonfuel mineral production in Colorado[1]**

| Mineral | | 1983 | | 1984 | |
|---|---|---|---|---|---|
| | | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays | thousand short tons | 459 | $2,650 | 308 | $2,111 |
| Gem stones | | NA | 80 | NA | 80 |
| Gold (recoverable content of ores, etc.) | troy ounces | 63,063 | 26,739 | 60,010 | 21,643 |
| Gypsum | thousand short tons | W | W | 291 | W |
| Sand and gravel: | | | | | |
| Construction | do | [e]21,200 | [e]81,600 | 28,024 | 87,324 |
| Industrial | do | 212 | 3,233 | 149 | 2,213 |
| Silver (recoverable content of ores, etc.) | thousand troy ounces | 2,146 | 24,546 | 2,200 | 17,909 |
| Stone: | | | | | |
| Crushed | thousand short tons | 6,790 | 22,749 | [e]7,200 | [e]26,200 |
| Dimension | do | 1 | 86 | [e]1 | [e]87 |
| Combined value of cement, copper, iron ore, lead, lime, molybdenum, peat, perlite, pyrites (1984), salt (1984), tin (1984), tungsten ore and concentrate, vanadium, zinc, and values indicated by symbol W | | XX | [r]175,969 | XX | 278,515 |
| Total | | XX | 337,652 | XX | 436,082 |

[e] Estimated. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

### Table 2.—Value of nonfuel mineral production in Colorado, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adams | $12,456 | (2) | |
| Alamosa | W | W | Peat. |
| Arapahoe | W | W | Sand and gravel (industrial). |
| Boulder | 32,825 | W | Cement, stone (crushed), gold, clays, silver, peat, lead, copper. |
| Chaffee | 139 | W | Lime, peat. |
| Clear Creek | 75,899 | W | Molybdenum, gold, silver, copper, lead. |
| Costilla | (3) | W | Stone (crushed). |
| Crowley | W | (2) | |
| Custer | W | W | Perlite. |
| Delta | 870 | (2) | |
| Denver | W | (2) | |
| Dolores | (3) | $471 | Stone (crushed). |
| Douglas | W | W | Sand and gravel (construction), clays, sand and gravel (industrial). |
| Eagle | 2,419 | W | Silver, stone (crushed), gold, copper, lead. |
| Elbert | W | W | Clays. |
| El Paso | W | 3,162 | Stone (crushed), clays. |
| Fremont | W | W | Cement, stone (crushed), gypsum, clays. |
| Garfield | 1,513 | W | Stone (crushed). |
| Gilpin | 120 | W | Gold, silver, lead, copper. |
| Grand | W | (2) | |
| Gunnison | 346 | (2) | |
| Huerfano | 7 | (2) | |
| Jackson | 41 | (2) | |
| Jefferson | 7,449 | 12,361 | Stone (crushed), clays. |
| Kit Carson | 137 | -- | |
| Lake | 110,656 | W | Molybdenum, zinc, silver, gold, lead, tungsten, copper. |
| La Plata | W | W | Silver, lead. |
| Larimer | 12,321 | 4,263 | Cement, stone (crushed), sand and gravel (industrial), gypsum, lime, stone (dimension). |
| Logan | W | W | Lime. |
| Mesa | W | W | Vanadium. |
| Mineral | W | W | Silver, lead, copper. |
| Moffat | W | (2) | |
| Montezuma | W | (2) | |
| Montrose | 16,066 | W | Vanadium. |
| Morgan | W | W | Lime. |
| Otero | W | (2) | |
| Ouray | W | (2) | |
| Park | W | 774 | Gold, peat, silver, lead, copper. |
| Phillips | 9 | (2) | |
| Pitkin | W | W | Iron ore. |
| Prowers | 590 | (2) | |
| Pueblo | W | 145 | Clays. |
| Rio Blanco | W | (2) | |
| Rio Grande | W | (2) | |
| Routt | 404 | 425 | Stone (crushed). |
| Saguache | W | (2) | |
| San Juan | 25,895 | W | Gold, zinc, silver, lead, copper. |
| San Miguel | W | W | Vanadium, gold, silver. |
| Sedgwick | W | W | Lime. |
| Summit | W | (2) | |
| Teller | 3,303 | W | Gold, peat, stone (crushed). |
| Washington | 69 | (2) | |
| Weld | W | W | Lime. |
| Undistributed[4] | [r]304,506 | 234,450 | |
| Sand and gravel (construction) | XX | [e]81,600 | |
| Stone: | | | |
| Crushed | [e]27,800 | XX | |
| Dimension | [r] [e]86 | XX | |
| Total[5] | [r]635,920 | 337,652 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Colorado business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 3,071 | 3,146 | 3,178 |
| Total civilian labor force | do | 1,590 | 1,668 | 1,707 |
| Unemployment | do | 123 | 111 | 96 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 42.3 | 36.1 | 36.0 |
| Metal mining | do | 8.4 | 5.5 | 6.1 |
| Nonmetallic minerals except fuels[2] | do | .9 | .8 | NA |
| Coal mining[2] | do | 4.8 | 3.9 | NA |
| Oil and gas extraction | do | 28.5 | 26.0 | 25.3 |
| Manufacturing total | do | 183.3 | 180.7 | 192.3 |
| Primary metal industries[2] | do | 5.3 | 3.7 | NA |
| Stone, clay, and glass products | do | 10.3 | 9.1 | 9.6 |
| Chemicals and allied products | do | 7.5 | 7.7 | 8.3 |
| Petroleum and coal products[2] | do | .9 | .9 | NA |
| Construction | do | 82.9 | 83.0 | 88.3 |
| Transportation and public utilities | do | 85.4 | 83.7 | 85.8 |
| Wholesale and retail trade | do | 320.4 | 326.2 | 340.0 |
| Finance, insurance, real estate | do | 83.5 | 87.0 | 93.3 |
| Services | do | 280.0 | 289.7 | 305.4 |
| Government and government enterprises | do | 238.6 | 240.7 | 243.8 |
| Total[3] | | 1,316.6 | 1,327.2 | 1,384.8 |
| Personal income: | | | | |
| Total | millions | $37,601 | $40,170 | $44,004 |
| Per capita | | $12,246 | $12,770 | $13,847 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 39.9 | 40.9 |
| Total average hourly earnings, production workers | | $8.63 | $8.97 | $9.24 |
| Earnings by industry: | | | | |
| Farm income | millions | $448 | $552 | $676 |
| Nonfarm | do | $27,704 | $29,396 | $32,178 |
| Mining total | do | $1,638 | $1,395 | $1,463 |
| Metal mining | do | $254 | $186 | $203 |
| Nonmetallic minerals except fuels | do | $20 | $17 | $17 |
| Coal mining | do | $180 | $155 | $166 |
| Oil and gas extraction | do | $1,184 | $1,037 | $1,077 |
| Manufacturing total | do | $4,544 | $4,714 | $5,252 |
| Primary metal industries | do | $191 | $125 | $133 |
| Stone, clay, and glass products | do | $265 | $256 | $298 |
| Chemicals and allied products | do | $209 | $236 | $270 |
| Petroleum and coal products | do | $35 | $38 | $41 |
| Construction | do | $2,143 | $2,253 | $2,437 |
| Transportation and public utilities | do | $2,516 | $2,693 | $2,860 |
| Wholesale and retail trade | do | $4,734 | $5,001 | $5,520 |
| Finance, insurance, real estate | do | $1,643 | $1,954 | $2,225 |
| Services | do | $5,334 | $5,857 | $6,542 |
| Government and government enterprises | do | $5,037 | $5,405 | $5,741 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 31,913 | 51,426 | 43,210 |
| Value of nonresidential construction | millions | $1,225.4 | $1,245.3 | $1,743.1 |
| Value of State road contract awards | do | $141.0 | $137.0 | $305.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 1,488 | 1,504 | 1,704 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $635.9 | $337.7 | $436.1 |
| Value per capita | | $207 | $107 | $137 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

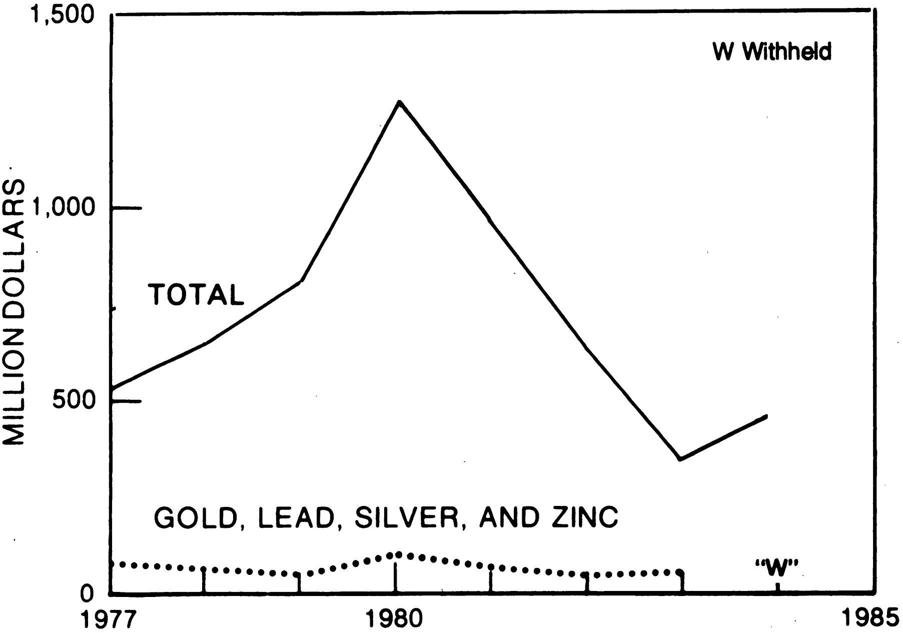

**Figure 1.—Value of mine production of gold, lead, silver, and zinc and total value of nonfuel mineral production in Colorado.**

**Trends and Developments.**—Among the metals, shipments of molybdenum tripled over that of a year earlier as stockpiles were worked down and demand stabilized. The market remained weak and prices low, and although the State's two molybdenum mines reopened, they operated at less than 50% capacity. Output of gold and silver remained little changed from that of 1983, but a decline in prices meant a substantially lower total value for each. Copper, lead, and zinc output rose moderately and higher prices for lead and zinc led to substantially higher total returns; copper prices continued to decline. All the nonmetallics, except clays, benefited from a 40% increase in value of nonresidential construction and a 123% increase in value of State road contract awards.

Colorado ranked first in the Nation in output of molybdenum and vanadium, second in tungsten and tin, third in lead, fourth in zinc, and sixth in gold and silver.

Employment in mining was about 36,000 workers, about 3% of total employment in the State. Coal and nonmetallic mining employed about 4,700, according to the Colorado Division of Employment. Total earnings in nonfarm employment in the State were about $32.2 billion, of which total mining accounted for about $1.5 billion and nonfuels mining, $220 million. The per capita value of nonfuel mineral production was $137, compared with a national average of $98.

Colorado's economic upturn lagged that of the Nation by 6 months but started moving up at the end of 1983. Unemployment in the State was about 5.1% in 1984, compared with a 7.1% national rate. Mining, together with agriculture, was the only economic sector that did not share in a strong economic growth year in Colorado. The mining industry generally continued its slump of the past 3 years. Although hopes were high for gold and silver at the beginning of the year, by yearend, all but one of the State's major base and precious metals mines were closed or operating at reduced levels, and several minerals exploration companies had closed their Denver offices.

In an interesting counterpoint to the State's mining slump, Golden Recycle Co., a subsidiary of Adolph Coors Co. of Golden, opened a new $40 million aluminum recycling mill at Fort Lupton. The mill shredded used aluminum beverage cans, melted them, and turned the recycled aluminum into coils of sheet aluminum for manufacture into can lids at Coors' can manufacturing plant in Golden. The mill employed 100

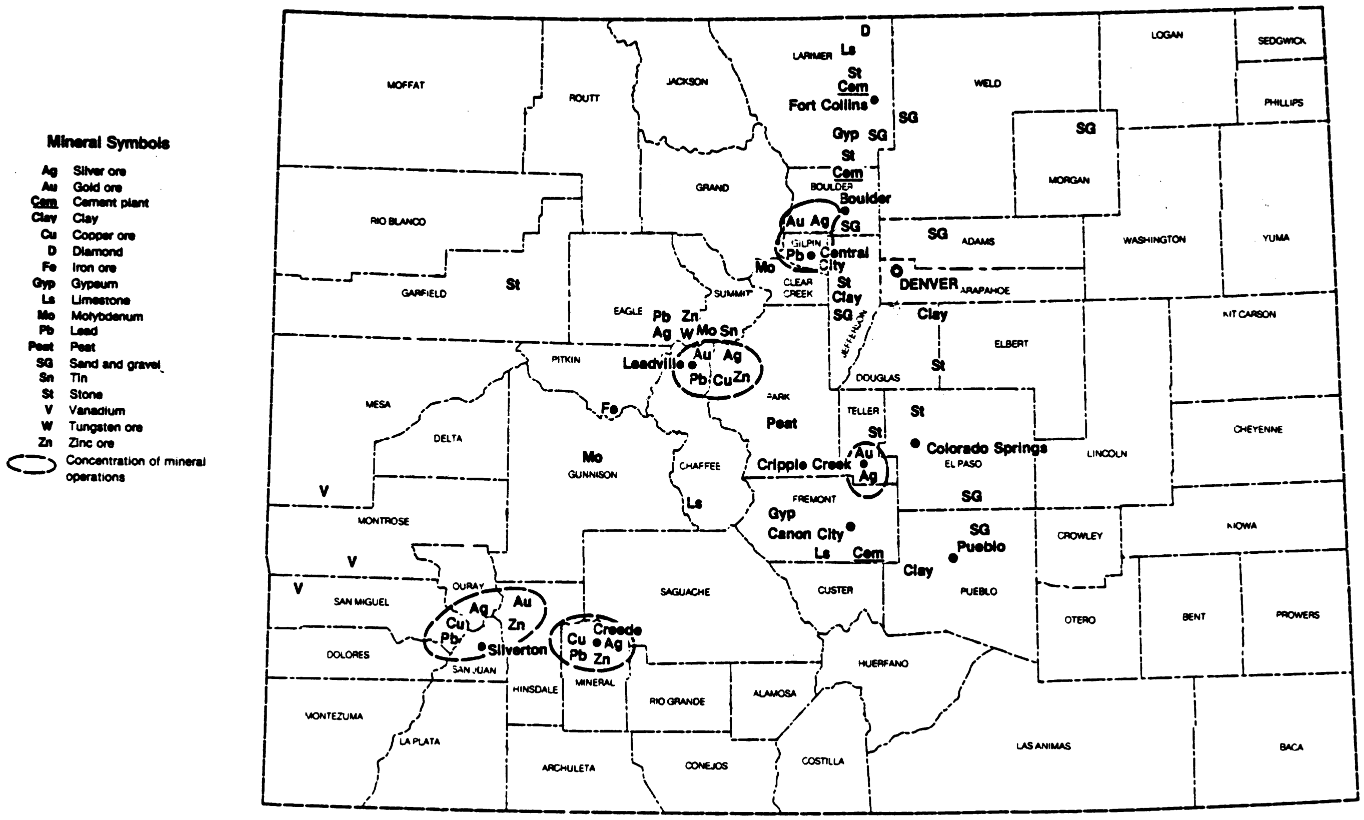

Figure 2.—Principal mineral producing localities in Colorado.

people and had a capacity of 250,000 pounds of used aluminum beverage cans daily. It was expected to supply material for 20% of Coors' can needs. Recycled metal supplies about 80% of Coors' aluminum requirements.

**Exploration Activities.**—A few trends seemed to be apparent in mineral exploration in Colorado. Because of the high cost and risk involved, exploration in unknown areas declined while interest in old districts and properties where information already existed was high. The percentage of total exploration budgets spent for gold and silver exploration increased. Technological improvements in mechanization of mining and in mineral processing, especially the trend toward direct leaching, also affected the sort of exploration targets sought. Precious metals exploration continued to be commonly undertaken by new, smaller companies whose targets were also smaller. Increasingly, these companies were foreign-owned firms, particularly British and Canadian. Several major oil companies, which entered the minerals exploration and development field several years ago, reduced operations or withdrew from the minerals field altogether. Falling precious metals prices toward the end of the year affected the level of activity.

The list of exploration projects for gold and silver was a long one. Some of the more notable activities in gold and silver exploration are included in the appropriate mineral commodity sections in this chapter.

**Legislation and Government Programs.**—Little legislation of specific interest to the mining industry was enacted in Colorado in 1984. Among bills that passed were H.B. 1208, which increased the amount of coal production excluded from the severance tax from 8,000 short tons per quarter per company to 25,000 tons per quarter, and H.B. 1050, which declared that a mineral in the ground, whether known or unknown, shall not be considered in determining the value of a mine for purposes of taxation.

A bill adding 565,000 acres of new wilderness to the existing 2.5 million acres of wilderness in Colorado was defeated in the Congress of the United States because of a controversial provision to deny the Federal Government reserved water rights on wilderness designated land.

Colorado's Department of Natural Resources received $422,447 from the U.S. Department of the Interior's Office of Surface Mining (OSM) in 1984, bringing the total received from OSM to more than $10 million for 73 mine projects.

Fourteen potentially hazardous waste sites in Colorado were on the Environmental Protection Agency's (EPA) cleanup list under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund). Newly added in 1984 were the Eagle Mine, a former silver and zinc mine at Gilman; the Uravan uranium-vanadium mill, south of Grand Junction; and the Smuggler Mine, a lead-silver mine near Aspen. Other mining sites in Colorado already on the list included California Gulch near Leadville and the Central City area. No timetable was established for cleaning up these sites. The State of Colorado filed suit against owners of several sites, including those of the Eagle Mine.

Mineral leasing activity on Federal lands, mostly for oil and gas, increased in 1984. The State of Colorado received $49 million as its share of lease and royalty payments to the Federal Government. In addition, the State received another $7.6 million as payment in lieu of taxes of the approximately 36% of the State surface that is federally owned. Approximately 200,000 mineral claims were on Federal land in Colorado.

The Mining and Mineral Resources Research Institute, at the Colorado School of Mines (CSM) and integrated into the CSM program of graduate studies and research, pursued a cooperative program in mined land research with Colorado State University and a program in pyrometallurgy with the University of Utah and the University of Missouri.

The Colorado Geological Survey, in marking the 15th year of its reestablishment, continued to provide and ensure the utilization of appropriate geologic information in public and private decisionmaking in the State of Colorado. A reduction in State funding from $632,000 in 1983 to $139,000 in 1984 caused a reduction in State-funded staffing from 16 to 3, but an additional 10 positions remained authorized by cash funding. The Survey was successful in generating sufficient cash income from other sources to maintain those positions in 1984. Survey activities included mapping sand and gravel of the Front Range and Mesa, Moffat, and Routt Counties; mapping Colorado's oil and gas fields; mapping the State's mineral resources; and investigations of the State's coal and water resources. Geological hazards were mapped, and problems related to oil shale development, underground nuclear detonations, landslides, swelling soils, ski area development, subdivision construction in hazardous areas, and other construction consumed much of the Survey staff's efforts.

# REVIEW BY NONFUEL MINERAL COMMODITIES

## NONMETALS

**Cement.**—Shipments of both portland and masonry cement in Colorado in 1984 increased about 20% over that of 1983. Colorado ranked 16th of the 40 States that had producing plants. Recovery in the construction industry was credited with increased demand for cement. All three of Colorado's cement plants were in operation during the year. Ideal Basic Industries Inc.'s Boettcher plant, north of Fort Collins, resumed operations March 1, after being closed since October 1982; 70 employees were recalled. Ideal's other Colorado cement plant, the Portland plant near Florence, Fremont County, was the State's largest. The State's third cement plant, Martin Marietta Corp.'s Lyons plant in Boulder County, was sold in February to Southdown Inc. of Houston, TX, for $45 million plus inventories and receivables at valuation. Southdown's Southwestern Portland Cement Co. unit will operate the plant.

All three plants produced mostly Types I and II, moderate-heat-resistant-type gray cement. The Portland and Lyons plants also produced small amounts of masonry cement. More than two-thirds of cement output went to ready-mixed concrete companies. Most of the balance went to concrete product manufacturers and other contractors. Most of the cement produced was shipped in bulk, more than one-half by rail.

Ideal's Portland plant had three kilns and a productive capacity of about 885,000 short tons annually. Ideal's Boettcher and Southdown's Lyons plants each had one kiln and productive capacities of about 460,000 tons and 430,000 tons, respectively. Ideal planned to relieve production problems at the Boettcher plant by modifying its blending and pyroprocessing systems.

Ideal experienced its best year since 1981, with an operating loss of $2.1 million in its cement operations in 1984, compared with a $12.7 million loss in 1983. Its western region, which includes Colorado, had a particularly good year, despite problems at Boettcher.

**Clays.**—Colorado was not a major producer of clay, with little more than 0.5% of the total national output. The quantity of clay produced in the State in 1984 was about one-third less than in 1983. Of the clay produced in the State, 95% was common clay used for the manufacture of bricks. A small amount of fire clay and a very small amount of bentonite were also produced.

**Gem Stones.**—In 1984, Colorado was the source of about 1% of the value of gem stones produced in the Nation. Turquoise was produced in Conejos County and, reportedly, Teller County. Superior Minerals Co. continued its evaluation of the commercial potential of diamonds occurring in kimberlite pipes in the Colorado-Wyoming State line area; Cominco American Incorporated reduced its effort there.

**Gypsum.**—Crude gypsum was reportedly produced by two companies in Colorado in 1984, one at Coaldale, Fremont County, and one at Woodhams, Larimer County. The quantity produced increased substantially over the 1983 level. Genstar Building Materials Co. of Florence, the largest producer, also calcined gypsum at its wallboard plant. Colorado's crude gypsum output was just 2% of the national total.

Several small gypsum mines, such as the one opened by R. A. Mining Co., which mined 10 acres at a time on a 160-acre site near the town of Gypsum and whose plans were approved by the Eagle County Commissioners in March, and the Lackey Mine, south of Swissvale, which had been granted a special use permit by the Fremont County Commissioners in March, represent small mines that were inactive in 1984.

**Lime.**—Quicklime was produced by Calco Inc. in Chaffee County and by The Great Western Sugar Co. in Larimer, Logan, Morgan, Sedgwick, and Weld Counties. The amount produced in 1984 was similar to that produced in 1983. Great Western used its quicklime in the processing of sugar beets. Financially troubled Hunt International Resources Corp. of Dallas, parent company of Great Western, notified sugar beet growers' associations in December of its intent to sell Great Western's 14 sugar processing operations. Sugar producers faced a dwindling market for sugar as a health-conscious public reduced its annual sugar consumption from 91 pounds per capita in 1978 to about 68 pounds in 1984.

**Peat.**—Peat was produced by four companies in four counties, Boulder, Chaffee, Park, and Teller. The quantity produced was little changed from that of 1983. Universal Peat Co. in Park County produced nearly two-thirds of the total from humus material. The other producers used reed-sedge material. Nearly one-half the output went into mixed fertilizers; general soil improvement and pottery soil consumed most of the balance, with a small amount going to golf courses. About twice as much material was delivered in bulk as in packages, but the packaged material sold for about double the amount charged for bulk material. Colorado's peat production ranked fifth of 22 States but was under 10% of the national total.

**Perlite.**—Reported perlite production in Colorado in 1984 was similar to that produced in 1983. Two companies reported production in the State. Persolite Products Inc. produced perlite from its Rosita Mine in Custer County. Mine output was shipped to Persolite's expanding plant in Florence, 36 miles away. The second company, Grefco Inc., much the larger of the two, expanded perlite from No Agua, NM, at its plant in Antonito, CO. Grefco announced it had enlarged its production of expanded perlite through the acquisition of Chemrock Corp. of Nashville, TN. None of Chemrock's plants were in Colorado. Perlite was used as filter aid, cavity-fill insulation, concrete aggregate, fillers, horticultural aggregate, low-temperature insulation, and plaster aggregate.

**Salt.**—Union Carbide Corp. purchased salt in the form of brine from a well in Montrose County for use in the company's uranium-vanadium mill at Uravan. Salt production was related to needs at the mill, which was closed part of the year.

**Sand and Gravel.**—Sand and gravel output in Colorado increased substantially in 1984, compared with that of 1983, because of a revival in the construction industry and was the third most valuable nonfuel mineral produced in the State, after molybdenum and cement.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

Production of construction sand and gravel increased 32% in quantity and 7% in value over 1983 levels, reflecting an upsurge in nonresidential construction and road-building projects. About one-fourth of construction sand and gravel was used in concrete aggregate, one-fourth for road base and coverings, more than one-fourth in other unspecific uses, and the balance for asphaltic concrete, fill, snow and ice control, concrete products, railroad ballast, and plaster and gunite sands.

In 1984, 112 companies and 22 county highway departments reported producing construction sand and gravel at 219 operations in 50 counties in Colorado. Adams County was the largest producer, with more than 20% of the State total, followed by El Paso with 12%; Weld, 10%; Jefferson and Larimer, 8% each; and Arapahoe and Boulder, 5% each. The leading producing companies were Mobile Pre-Mix Concrete Inc., Cooley Gravel Co., and the group of Koppers Co. Inc. sand and gravel companies. A second group of major producers included Flatiron Sand and Gravel Co., Albert Frei and Sons, Castle Concrete Co., and Zigan Sand and Gravel Inc. These seven major producers accounted for about one-half of total output. Almost all the construction sand and gravel that was transported to point of consumption was shipped by truck. Average unit value was $3.12 per short ton, with values ranging from $1.62 to $6.13 per ton.

### Table 4.—Colorado: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 7,148 | $30,913 | $4.33 |
| Plaster and gunite sands | 45 | 277 | 6.13 |
| Concrete products | 56 | 220 | 3.94 |
| Asphaltic concrete | 3,053 | 8,159 | 2.67 |
| Road base and coverings[1] | 7,037 | 18,523 | 2.63 |
| Fill | 1,613 | 2,613 | 1.62 |
| Snow and ice control | 199 | 687 | 3.44 |
| Railroad ballast | 53 | 162 | 3.04 |
| Other[2] | 8,820 | 25,770 | 2.92 |
| Total or average | 28,024 | 87,324 | 3.12 |

[1] Includes road and other stabilization (cement).

[2] Includes other unspecified uses.

*Industrial.*—The quantity of industrial sand produced was only about 0.5% of the amount of construction sand and gravel output. It was produced in Arapahoe, Douglas, El Paso, and Larimer Counties by four companies; Larimer County was the major source. Its value ranged from $6 to $28 per ton, and it was used for sandblasting, roofing granules, filtration, traction, and other unspecific uses.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Almost all of the stone produced was crushed stone. Production increased about 6% in volume and 15% in value over 1983 levels. A rise in nonresidential and road construction accounted for the increased demand.

## METALS

**Copper.**—Copper was produced in Colorado only as a byproduct of other metal production. Copper occurred in Colorado's complex ores along with gold, lead, silver, and zinc, but provided only about 2% of the total value of the base and precious metals produced. Eleven mines in eight counties reported producing copper. Standard Metals Corp.'s Sunnyside Mine near Silverton was the source of nearly 80% of the State's copper in 1984. ASARCO Incorporated's Leadville Unit (Black Cloud Mine) and Homestake Mining Co.'s Bulldog Mountain Mine at Creede produced most of the balance. Colorado ranked ninth of 10 States producing copper in 1984, contributing only a small fraction of the total.

**Gold.**—Output of gold in Colorado was down slightly for the second year in a row, following recovery from the 1979 low. Lower prices for gold was the primary reason; gold prices fell from an average $424 per troy ounce in 1983 to an average $361 in 1984. Fourteen mines in ten counties reported gold production in Colorado in 1984. This number does not reflect the large number of very small mines in some stage of exploration or development.

The Sunnyside Mine near Silverton, operated by Standard Metals, continued to be the State's major producer, with over 50% of total gold output. The Black Cloud Mine, or Leadville Unit, of Asarco at Leadville, followed in amount of gold produced, although the amount was much less than that of the Sunnyside; Draco Mines Ltd.'s Crystal Hill Mine in Saguache County was third in gold production, again at a considerably lower level of output than the next larger producer. These three mines accounted for 94% of the State's total gold production.

Output of three smaller mines, the Victor (Iron Clad) Mine in Teller County, Golden Wonder in Hinsdale County, and Franklin Consolidated Mine in Clear Creek County, brought the total to 99% of the State's gold output in 1984. With the exception of the Black Cloud, gold was the most important product of all of these mines. Gold was first in value of the base and precious metals produced in Colorado. Colorado ranked sixth of the 12 States producing gold in 1984; Colorado's output was only about 3% of the national total.

In the Cripple Creek-Victor District, a major gold-producing area early in the century, Hecla Mining Co., in a joint venture with Golden Cycle Gold Corp., conducted a major underground exploration program at the Ajax Mine properties. Hecla had taken over Texasgulf Minerals and Metals Inc.'s role as operator of the joint venture Cripple Creek and Victor Gold Mining Co. in August 1983. The group controlled a major share of the properties in the old district. In the first week of July, Hecla shut down its operation, reporting that results warranted no further exploration. The Cripple Creek operation's 40 employees were laid off. Hecla's decision may also have been related to a change in corporate priorities related to its acquisition of Ranchers Exploration and Development Corp. in May. Hecla withdrew from the joint venture, and Texasgulf resumed its role as manager of the venture. No plans to reopen the Ajax operation were announced. The group did express an interest in evaluating the heap leaching potential of waste piles on the property.

Silver State Mining Corp., developer of the Iron Clad Mine, a successful open pit, enclosed vat leaching operation since 1982, entered into a joint venture agreement with Nerco Minerals Co., a subsidiary of Pacific Power and Light Co. of Portland, OR, for expanded operation of the mine near Victor. Nerco Minerals acquired 60% of the operation for $3.5 million in cash and assumption of $4.3 million of Silver State's liabilities. The 80 mine employees were laid off April 30, pending completion of the agreement and Nerco Minerals' plans to expand the operation from 1,000 short tons of ore per day to 3,000 tons per day, or from about 20,000 ounces of gold per year to 60,000 ounces per year. Forty employees were rehired in July when Nerco Minerals received preliminary operating permits. Completion of the expanded facility was scheduled for early 1985.

Three cyanide spills at two different operations near Victor, caused by heavy rains in August, prompted the Teller County Commissioners to reassess cyanide heap leaching regulations.

In the San Juan area, the State's largest gold producer, the Sunnyside Mine operated by Standard Metals, completed a record high production of 276,000 tons and net profits of $3.4 million in 1983 and anticipated even greater production in 1984. An agreement was made with Noranda Exploration Corp. and Callahan Mining Corp. to explore and develop claims adjacent to the Sunnyside. In January, the company announced an intercept with the Little Mary vein and discovery of the Portland vein, which increased proven reserves by 29,000 tons averaging 0.38 ounce of gold and 4.0 ounces of silver per ton. Probable reserves were increased by 33,000 tons, containing 0.47 ounce of gold and 4.2 ounces of silver per ton. With these additions, the Sunnyside had the highest gold reserves in its history. Introduction of a rubber-tire, load-haul-dump unit reduced unit costs and increased productivity. In late March, a high-speed haulage crosscut to the Little Mary vein was completed. However, on March 5, Standard Metals filed for chapter 11 bankruptcy in a Denver Federal court. The Sunnyside itself was profitable and continued operating after the bankruptcy filing.

A loan of $2.5 million from the Canadian Imperial Bank of Commerce permitted continued operation of the mine for a period of time. However, cash-flow problems led to furloughing about 100 of the mine's 275 workers on September 5. The planned 2-week furlough continued through the rest of the year. Production continued at about 17,000 tons of ore per month. The Sunnyside, which was the Nation's 18th largest gold producer, also was Silverton's major employer, and cutbacks at the mine had immediate effects on the community.

Also in the San Juan area, Gerber Minerals Corp., a subsidiary of Gerber Energy International Inc. of Denver, acquired control of the Gold King Mine, a property consisting of 212 acres adjacent to the Sunnyside Mine at Silverton. The Gold King had been idle since 1907.

The Crystal Hill Mine near La Garita in Saguache County was a joint venture of Wytana Inc. and Draco Mines Ltd. The strip mine processed 20,000 tons of low-grade ore per week using a cyanide heap leach system to process the ore. At the 9,240-foot elevation, the leaching operation closed down during winter months, although ore breaking and hauling could continue throughout the year.

In Boulder County, the Cash Mine, a joint venture of the Charles A. Steen family, owners of the mine, and Cosmos Resources Ltd. of Canada, continued preproduction development. Discovered in 1872, the Cash, historically one of the most productive mines in the Gold Hill mining district, was inactive periodically between 1919 and the current development.

Cobb Resources Corp. reported discovery of a new ore vein at the London Mine near Fairplay, Park County, which consisted of as much as 8 feet of high-grade mineralization assayed at 3.75 ounces of gold per ton.

Anaconda Minerals Co. gave up its search for gold at Summitville in March after spending 4 years and more than $6 million in the effort. Galactic Resources Inc. of Canada signed a lease agreement on the same property in April with Reynolds Mining Co., the property owner. Announcement by Galactic of a possible million-ounce gold reserve at Summitville spurred a land rush by other Canadian firms. Galactic said the ore body averaged 0.045 ounce of gold and runs to 0.123 ounce per ton. Although the property was at the 11,000-foot elevation, Galactic proposed using a heap leach method of recovery for surface mined ore.

Among the many small operations in the Clear Creek area, Marquette Minerals Inc. entered a joint venture with Aberford Resources Ltd. of Canada to explore and develop the Grace gold property near Empire. Moritz Mining Co. formed a partnership to reopen the Lowe placer on Clear Creek, east of Idaho Springs, where it estimated reserves of 0.5 million to 1 million cubic yards of gold-bearing gravels grading 0.01 to 0.05 ounce or more of gold per cubic yard of gravel on a 32-acre streambed site.

In northwestern Colorado near Craig, Marathon Gold Corp., in a joint venture with Hampton Gold Mining Areas PLC of the United Kingdom, continued exploration and development of a large property the company believed has a large amount of micrometer-size gold, although no proven reserve has yet been established. Marathon, which planned an open pit operation, poured a small gold ingot for visiting stockholders and announced that Rhône-Poulenc Chemicals Co., Paris, France, intended to purchase 4,000 tons per year of the rare earths monazite and xenotime, which were expected to be produced as byproducts from Marathon's gold operations.

Lake City Mines Inc., Hinsdale County, sought protection under chapter 11 of the Bankruptcy Act in a Denver Federal court March 2. Lake City Mines formed a joint venture with LKA International of Seattle, WA, which will continue to operate the company's main property, the Golden Wonder Mine.

Among numerous other gold exploration and development projects in the State, Exxon Corp. continued exploration on Sierra Resources Inc.'s Bessie G project in La Plata County, with apparently encouraging results, and Wright Engineering and Exploration Corp. moved toward reopening a placer operation on Cadre Creek in Chaffee County, a large placer gold producing area from 1860 through the 1920's.

**Table 5.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county**

| County | Mines producing[1] | | Material sold or treated[2] (metric tons) | Gold | | Silver | | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Troy ounces | Value | Troy ounces | Value | Metric tons | Value | Metric tons | Value | Metric tons | Value | |
| 1982, total | 24 | 4 | 883,700 | 64,584 | $24,277,771 | 1,934,312 | $15,377,781 | 575 | $922,306 | W | W | W | W | $61,016,585 |
| 1983, total | 15 | 1 | 1,017,259 | 63,063 | 26,738,712 | 2,145,616 | 24,545,846 | W | W | W | W | W | W | W |
| 1984: | | | | | | | | | | | | | | |
| Boulder | 1 | -- | W | W | W | W | W | -- | -- | -- | -- | -- | -- | W |
| Clear Creek | 3 | -- | W | W | W | W | W | W | W | W | W | -- | -- | W |
| Eagle | 1 | -- | W | W | W | W | W | W | W | W | W | -- | -- | W |
| Hinsdale | 1 | -- | W | W | W | W | W | W | W | W | W | -- | -- | W |
| Lake | 2 | -- | W | W | W | W | W | W | W | W | W | W | W | W |
| Mineral | 1 | -- | W | -- | -- | W | W | W | W | W | W | -- | -- | W |
| Ouray | 2 | -- | W | W | W | W | W | W | W | W | W | -- | -- | W |
| Park | 2 | -- | W | W | W | W | W | W | W | W | W | -- | -- | W |
| Saguache | 1 | -- | W | W | W | W | W | -- | -- | -- | -- | -- | -- | W |
| San Juan | 1 | -- | W | W | W | W | W | W | W | W | W | W | W | W |
| Teller | 1 | -- | W | W | W | W | W | -- | -- | -- | -- | -- | -- | W |
| Total | 16 | -- | [3]903,525 | [3]60,010 | [3]21,643,088 | [3]2,199,888 | [3]17,908,540 | W | W | W | W | W | W | W |

W Withheld to avoid disclosing company proprietary data.

[1] Operations from which gold and silver are recovered as byproducts from sand and gravel operations are not counted as producing mines.

[2] Does not include gravel washed.

[3] Includes items indicated by symbol W.

### Table 6.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by type of material processed and method of recovery

| Type of material processed and method of recovery | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|
| Lode: | | | | | |
| Amalgamation | W | -- | -- | -- | -- |
| Cyanidation | W | W | -- | -- | -- |
| Smelting of concentrates | W | 2,158,726 | W | W | W |
| Direct smelting of ore | W | W | W | W | -- |
| Total | [1]60,010 | [1]2,199,888 | W | W | W |

W Withheld to avoid disclosing company proprietary data.
[1] Includes items indicated by symbol W.

### Table 7.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by class of ore or other source material

| Source | Number of mines | Material sold or treated (metric tons) | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|---|---|
| Lode ore: | | | | | | | |
| Dry gold[1] | 7 | W | W | W | W | W | W |
| Gold-silver | 2 | W | W | W | W | W | -- |
| Silver | 5 | W | 267 | W | W | W | -- |
| Total | 14 | W | W | W | W | W | W |
| Lead-zinc | 1 | W | W | W | W | W | W |
| Grand total | 15 | [2]903,525 | [2]60,010 | [2]2,199,888 | W | W | W |

W Withheld to avoid disclosing company proprietary data.
[1] Includes material that was leached.
[2] Includes items indicated by symbol W.

**Iron Ore.**—Colorado contributed a minute fraction of less than 1% to the Nation's total iron ore output. Pitkin Iron Corp.'s Cooper Mine near Ashcroft in Pitkin County, Colorado's only iron ore mine, continued limited operations in 1984. The primary customer for the mine's iron ore, CF&I Steel Corp., permanently shut down its blast furnaces in 1983 and no longer utilized iron ore in its operations. Pitkin Iron, however, continued to ship material from stockpile to Ideal's cement plant at Portland, CO, and Southwestern Portland Cement's plant at Lyons for use in cement production. The amount of material produced remained about the same as that of 1983. Pitkin Iron attempted to find additional use for its property by proposing a gravel pit operation on one portion of it but was refused permission by the Pitkin County Planning and Zoning Commission.

The State's only producer of iron and steel, CF&I, had its first profitable quarter, the second quarter of 1984, since the first quarter of 1982. The company, a subsidiary of Crane Co., reported $8.8 million in profits in 1984, compared with $94.2 million in losses for 1983. This included a $76 million write-down on a partially finished rail mill. The financially troubled steel mill permanently closed its four blast furnaces, two basic oxygen furnaces, lime kiln, and coke ovens in December 1983, ending its role as a primary iron producer and integrated steel mill. It had closed its Wyoming Sunrise iron ore mine in 1980 and its Monarch limestone quarry in 1981. It became a specialty steel mill one-half its former size, utilizing a system of electric furnaces, continuous casters, and finishing mills, fed with scrap steel, and had a capacity to produce nearly 1 million short tons of rails per year, tubular goods, wire products, and structural steel. About 2,400 jobs were eliminated, bringing the 1984 level to about 2,200 workers. The company sold off most of its assets and properties other than the steel mill itself. The Allen and Maxwell coal mines and some other undeveloped coal properties were sold to KN Energy Inc.; varying amounts of water storage in the Turquoise Sugarloaf Reservoir System were sold to the cities of Aurora, Pueblo, and Colorado Springs; and nearly 300,000 acres of land in Colorado was transferred to Crane in payment of debts owed. The Evergreen Land

Resource Co., a Crane subsidiary, was established to sell portions of this land. Crane continued looking for a buyer for CF&I, unsuccessfully in 1984. At yearend, Crane reportedly was considering spinning off CF&I to its stockholders as an independent company.

Several steel companies, including Bethlehem Steel Corp., joined with the Colorado School of Mines to form the University-Industry Steel Research Center, expecting to utilize the most modern research technology, including computerized techniques, to determine how best to produce the high-quality steel demanded by modern industry. With an initial grant of $150,000 from the National Science Foundation and $150,000 from industry sources, the center planned to do the fundamental research many companies could no longer afford.

**Lead.**—Lead was produced as a byproduct of other base and precious metals in Colorado. The State ranked third among 11 States producing lead in 1984 but was an insignificant contributor to total output. Lead production was reported by 10 mines in 8 counties but was not the most important product of any of those mines. Asarco's Leadville Unit accounted for more than one-half the total, and Standard Metals' Sunnyside Mine at Silverton, for most of the remainder; with Homestake's Bulldog Mountain Mine at Creede, these three mines were responsible for nearly all of the State's lead output. The amount of lead produced in Colorado in 1984 increased about 6% in volume and 24% in value over that of 1983. Lead accounted for only about 10% of the total value derived from base and precious metals output in the State in 1984.

**Molybdenum.**—Throughout 1984, world molybdenum production capacity substantially exceeded demand, resulting in an imbalance that was expected to continue for several more years. Colorado returned to the leading position among the seven States producing molybdenum after slipping to second in 1983 while Climax and Henderson were closed. Much of the other molybdenum production in the Nation was as a byproduct of copper production. AMAX Inc.'s two large molybdenum mines in Colorado were reopened in 1984 after being closed the entire year of 1983. Inventory drawdown during 1983 was cited by AMAX for the decision to reopen the mines to meet expected 1984 demands. Both mines, however, were operated at less than 50% capacity throughout the year. The Henderson Mine and mill near Empire, 40 miles west of Denver, shut down since October 2, 1982, reopened January 1, 1984. About 688 workers were recalled, compared with 2,000 working at the mine in the peak year of 1981 and about 775 when shut down.

The Climax Mine, atop 11,318-foot-high Fremont Pass near Leadville, was reopened April 18, 1984, after a 19-month closure. About 586 people were recalled to work the mine, compared with 3,050 people working there in the peak year 1981 and 650 when shut down September 18, 1982. A rotating work force of about 80 miners performed repairs and maintenance of the mines during their periods of closure; rotation of work crews gave part-time work to a larger number of people. Total manpower at the end of 1984 was 895 at Henderson and 804 at Climax.

According to AMAX's 1984 annual report, the two mines produced about 43.6 million pounds of molybdenum in 1984 and shipped somewhat more, including material withdrawn from stockpiles. Henderson produced about 26.8 million pounds of molybdenum in concentrates, and Climax, about 16.8 million pounds. This compared with zero production, but about 38.4 million pounds of molybdenum was shipped from inventory in 1983 and more than 102 million pounds was produced in the peak year 1981.

Reopening of the mines was good news to the small mountain communities where the miners live, most notably Leadville, which had the highest unemployment rate in the State (40%) after Climax was closed. The more than 1,300 workers rehired, plus the 100 or more at AMAX's Denver offices, earned pay of about $52 million in 1984, and the company paid more than $9 million in taxes to the six Colorado counties in which it operated.

The AMAX operating division, which included molybdenum, lost $11 million for the year, compared with losses of $105 million in 1983 and $143 million in 1982. The price of molybdenum (dealer oxide) declined from $3.90 per pound at the beginning of the year to $2.88 at yearend. Molybdenum continued to account for about 10% of AMAX's consolidated sales revenues.

Several structural and operating changes were made during the year. The Metals Group was reorganized into an Alloy Div., including molybdenum, a Base and Precious Metals Div., and a Specialty Products Section. Mining efficiency in 1984 was reported to be 35% higher than the base year 1964. The company reduced its debt substantially in 1984 and arranged for a buyback of about 4.3 million AMAX shares from British Petroleum Corp. Ltd.

Although operating at less than one-half capacity, AMAX continued development of both mines. Proven and probable ore reserves at the Climax Mine in 1984 were estimated to be 141 million short tons averaging 0.318% molybdenum disulfide in the open pit, and 267 million tons averaging 0.306% molybdenum disulfide underground. Corresponding reserves at the Henderson Mine were estimated to be 240 million tons averaging 0.376% molybdenum disulfide.

Excluding preparation and development expenditures, capital spending at Climax in 1984 was approximately $2.4 million, compared with $1 million in 1983; at Henderson, approximately $1.3 million in 1984, compared with $1.5 million in 1983. Among the changes in operations established during the year was to package molybdenum for shipment in bags rather than steel drums.

AMAX traded 5,814 acres of land held for exploration and development to the U.S. Forest Service in exchange for 2,943 acres on Bartlett Mountain expected to be affected by surface subsidence over the Climax Mine.

Molybdenum concentrates produced by AMAX in Colorado were shipped to its conversion plants in Langeloth, PA, Fort Madison, IA, Rotterdam, Netherlands, and Stowmarket, England. An independent molybdenum roaster in Denver, owned by S. W. Shattuck Chemicals Co., a subsidiary of Phibro-Salomon Corp., closed in March because of continuing unprofitability.

AMAX, which ceased development and wrote off $155 million on its Mount Emmons molybdenum prospect near Crested Butte in 1983, entered into an agreement in principle to transfer its working interests in that property to U.S. Energy Corp. and Crested Butte Silver Mining Inc., from which AMAX originally acquired them. The Mount Emmons Prospect was estimated to contain 165 million tons of molybdenum ore averaging 0.43% molybdenum disulfide, worth about $8 billion and costing about $1 billion to mine.

**Silver.**—Output of silver in Colorado in 1984 was very similar to the 1983 production level, but the value of that output was nearly one-third less because of a decline in average price of silver from $11.44 per troy ounce in 1983 to $8.14 per ounce in 1984. Nationally, Colorado accounted for about 5% of the silver production in 1984, ranking sixth among the States. Fifteen mines reported producing silver in 10 counties. Homestake's Bulldog Mountain Mine at Creede continued to be the largest producer. Asarco's Leadville Unit (Black Cloud Mine) and Hecla's Sherman Mine, both near Leadville, and Standard Metals' Sunnyside Mine at Silverton were next in size, but all three together did not equal the Bulldog's output. These four mines together produced more than 90% of the State's total silver in 1984. Silver was the most important product in four of the top six producers, but fourth after zinc, gold, and lead in the Black Cloud Mine and third after gold and zinc at the Sunnyside Mine. It was third in importance among the base and precious metals produced in Colorado.

According to Homestake's 1984 annual report, the Bulldog Mine produced slightly more silver in 1984 (1,275,000 ounces) than in 1983, but still less than in the several years before 1983. More ore was mined, but the average silver content was 13.9 ounces per short ton, compared with 16.7 ounces in 1983. Reserves remained high in 1984, 1,207,000 tons, but average silver content was estimated at 14.2 ounces per ton, compared with 15.2 ounces in 1983 and 16.1 ounces in 1982.

The carbon-in-pulp secondary recovery plant, used to recover silver from tailings after the flotation mill had removed most of the metal, had been reopened in December 1983 but was closed in July because low silver prices made it uneconomical to operate.

The company continued a major underground exploration project at the Equity Mine, about 8 miles from the Bulldog Mine, which included driving a decline, drifting, diamond drilling, bulk sampling, metallurgical testing, and engineering studies. Homestake confirmed it had struck silver and was trying to confirm the size of the ore body. Crown Resources Corp. and joint venture partner Sutton Resources Inc. signed an agreement enabling Homestake to acquire a 55% working interest in 331 claims totaling 6,000 acres adjacent to the Equity property.

Also at Creede, Minerals Engineering Co., in a joint project with Pioneer Nuclear Inc., drove an exploratory drift southwest from the Commodore Mine to further probe the Amethyst and Bulldog veins near an area where Homestake reported new vein discoveries last year. Diamond drilling and a geophysical survey were also part of the exploration program. A stock proxy and court battle to settle control of Minerals Engineering apparently was settled in favor of Pioneer Nuclear.

The Sherman Mine, at 12,400 feet above sea level near Leadville, was operated by Hecla through arrangement with the owner, Leadville Corp. Early in the year, the mine was producing at the rate of 150 tons per day, yielding 15.6 ounces of silver per ton and 0.5% lead. Although the drift through to the Hill Top Mine was completed, no mining was done in that portion of the property as ore on the Sherman side was richer. Lead-silver concentrates from the mill were shipped to the smelter at Trail, British Columbia, Canada, for smelting. On September 15, the mine and mill were shut down and 36 workers were laid off. Low silver and lead prices were cited as reasons for the closure. An agreement was reached between Hecla and Leadville Corp. for return of all Hecla's interest in the mine to Leadville Corp., leaving Hecla with no continuing interest in the operation. Leadville Corp. did not announce future intentions for the mine.

Also in the Leadville area, Mallon Minerals Corp. purchased 190 acres of claims leased to Asarco, operator of the Black Cloud Mine, the largest mine in the area. One of the most active organizations in the Leadville area was Leadville Silver and Gold Co., which acquired rights to, or was doing exploratory work on, the Iron Hill silver mine, the Rock Hill Mine Co. property, the Tucson-Maid Fault of the Tucson Mine, the Iowa Gulch Rex Group of claims, and the Pandora Mining Trust properties. Apache Energy and Minerals Co., developers of the Continental Chief Mine and Norsiga mill, filed for protection under chapter 11 of the Bankruptcy Act. Continental Resources Corp. acquired rights to the Sugar Loaf Prospect. Windsor Resources Inc. confirmed continuity of mineralization at the St. Kevin Mine, with samples averaging 22 ounces of silver per ton, 0.10 ounce of gold, 0.9% lead, and 2.9% zinc.

Work began July 1 on phase 1 of a restoration program at the Caribou Mine, 24 miles west of Boulder, and continued through the year. The Caribou Mine, which had been closed since 1955, was purchased in 1983 by North American Power Petroleums Inc., a Vancouver, British Columbia, Canada-based oil and mining company, from Nederland Mines of New York. Work being done under contract by Harrison-Western Corp. included widening a haulageway, a new electrical system, improvement of the mine effluent system, installation of pumps to dewater the 500-foot to 1,230-foot levels, and a new exploratory drift on the lowest level.

The Revenue-Virginius Mine near Ouray, being developed by Ranchers Exploration and Development, laid off part of its work force in August because of low silver prices.

Miocene Resources of California leased two silver mines in Gunnison that were productive at the turn of the century, the Fairview and the Cleopatra, and began exploration and development work in them.

**Tin.**—Tin was produced as a byproduct of molybdenum at AMAX's Climax Mine. Climax ore contains about 0.002% tin. Colorado was second of three States reporting tin production. Alaska was the major producer; Colorado accounted for less than 10% of the U.S. total. Colorado's tin production is directly related to output at the Climax Mine and, consequently, has been affected by reduced operating levels or suspended operations at that mine.

**Tungsten.**—Tungsten production in Colorado also is a byproduct of molybdenum production at AMAX's Climax Mine. Consequently, the output of tungsten in the State was affected by the reduced operating levels at Climax in 1984 and 1982 and complete suspension of operations at the mine in 1983. Colorado was second among the four States producing tungsten in 1984, with less than 20% of the national total output. AMAX's annual report indicated 29,000 short tons of tungsten trioxide was produced at Climax in 1984, compared with zero in 1983, 47,000 tons in 1982, and 111,000 tons in 1981. This output was sold principally in the United States. The U.S. tungsten prices rose from $66 per ton at the beginning of 1984 to $78 per ton by midyear, but settled back to $64 at yearend.

**Vanadium.**—Colorado remained first among the four States reporting vanadium production in 1984, although output was about 21% less than in 1983. Umetco Minerals Corp., a wholly owned subsidiary of Union Carbide, established in April 1984, was the only producer of vanadium in the State. Umetco's Uravan mill, the oldest uranium-vanadium mill in the United States, reopened on May 1 after a 5-month shutdown. It produced vanadium as a coproduct with uranium; vanadium and uranium coexist in western Colorado ores in a 5:1 ratio.

Most of Umetco's uranium-vanadium mines in Mesa, Montrose, and San Miguel

Counties were closed at the end of 1983, and most production was from stockpiled ore. About three-fourths of ore processed was from Umetco's own sources, and one-quarter was purchased. Umetco let five small contracts to receive ore from independent local miners during August through October to provide some cash flow among small miners. Umetco's vanadium finishing plant at Rifle was reopened in March, rehiring those of its 30-worker staff who had been laid off when it suspended operations 4 months earlier. Uravan was the only supplier of vanadium material to the Rifle plant.

Rifle operations were suspended again in mid-December, following the suspension of milling operations at Uravan in November. About 110 jobs were affected at Uravan. Production at both the Uravan and Rifle facilities was expected to be severely curtailed for the next few years until uranium supply and demand come back into balance; vanadium production is uneconomic without coproduction of uranium.

Hearings continued throughout the year on renewal of Uravan's mill and disposal site license; Uravan had been operating under a temporary license since 1978. The Radiation Control Div. of the Colorado Health Department had not accepted Umetco's proposals by yearend. The thickness of the clay liner (Umetco proposed 36 inches) at the company's Spring Creek disposal site was the main point in contention. Umetco signed an agreement with the Environmental Defense Fund in August, agreeing to close the Uravan mill and evacuate the town of Uravan in 1988 if radiation levels at that time remained above safety levels. About 200 people still lived in 70 of the town's 150 houses.

**Zinc.**—Zinc production in Colorado in 1984 was about 5% greater in volume and 23% greater in value than that of 1983. Colorado ranked fourth of the nine States reporting zinc production in 1984 but contributed well under 10% of the Nation's total output of zinc for the year. Only two mines in Colorado reported zinc production during the year. Asarco's Leadville Unit (Black Cloud Mine) was the largest producer. Standard Metals' Sunnyside Mine at Silverton was the other producer. Zinc was the major product of the Black Cloud Mine, second in value at the Sunnyside. Zinc was most important in value of the base metals produced in Colorado and second only to gold in the combined value base and precious metals output. It exceeded silver in value and was not far behind gold.

The largest producer of zinc in the State, Asarco's Leadville Unit, or Black Cloud Mine, a joint venture of Asarco and the Resurrection Mining Co., employed about 150 workers. Despite low metal prices, the mine had a record high production year in 1983, and with an increase in zinc prices from an average $0.41 per pound in 1983 to an average $0.49 in 1984, production increased slightly.

Because Asarco depended upon mine output to feed its smelters, which represented a large fixed investment independent of its mines, the company had a different set of considerations in determining what response to make to lower metal prices. Closing mines would not necessarily reduce expenditures to the same degree as with companies that were mining only. The company chose to tighten up on expenses and try to maintain sufficient cash flow to cover expenses but keep mines, including the Black Cloud, and smelters open.

A major controversy developed around one of Colorado's oldest and most productive zinc mines, the Eagle Mine, which is on the Eagle River at Gilman in Eagle County. Begun as a silver mine in 1879, gold production began in 1894 and zinc production began in 1905. It was bought by The New Jersey Zinc Co. in 1912. During the 1930's, it was Colorado's largest producer of copper and silver; beginning in 1936, it was the State's largest zinc producer. In 1971, it was the Nation's second largest zinc mine, producing 6 million short tons of zinc and 3 million tons of copper and silver ore. Its underground mill, constructed in 1929, processed 600 tons of ore per day. By 1978, the mine was no longer economic, the underground mill was removed, and mining curtailed—only higher grade gold-silver ore was being direct shipped to El Paso, TX, for processing. In the mid-1970's, Gulf + Western Industries Inc. (G+W) acquired New Jersey Zinc, and in 1983, sold the Eagle Mine, tailings, and mineral rights to Miller Enterprises of Canon City and the town of Gilman and 1,700 acres to Battle Mountain Corp. The mine closed in April 1984 when Miller Enterprises lost its financial backing, but some workers continued working the mine without pay for 2 more months in the hope that new financial backing would be found; it wasn't.

In June, EPA took over maintenance operations of the mine and paid the electric power bill to prevent the pumps from being shut off, which would have allowed the acid mine drainage to seep into the Eagle River and to corrode electric transformers containing 2,800 pounds of polychlorinated biphenyl (PCB). EPA stopped paying the electricity bills after moving the transformers out of the mine to the surface, and the mine was completely closed in August. Battle Mountain Corp. took over paying to keep the mine pumps running. In October, the mine received official priority status on EPA's Superfund list of hazardous waste sites.

Testing for the degree of hazard and determining a course of action will continue. The problem became a bureaucratic puzzle, with at least nine different Federal, State, and local agencies involved.

Several lawsuits remained to be settled concerning the mine; State officials brought suit against New Jersey Zinc and G+W because of pollution from the Eagle Mine. New Jersey Zinc, in turn, filed a suit against the State Mined Land Reclamation Board to force the transfer of their reclamation permit to Miller Enterprises.

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[2] Editorial assistant, Bureau of Mines, Denver, CO.

**Table 8.—Principal producers**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Ideal Basic Industries Inc.[1] | Box 8789<br>750 17th St.<br>Denver, CO 80201 | Plants | Fremont and Larimer. |
| Southwestern Portland Cement Co | 1111 South Colorado Blvd.<br>Denver, CO 80222 | Plant | Boulder. |
| Clays: | | | |
| Lakewood Brick and Tile Co | 1325 Jay St.<br>Lakewood, CO 80214 | Mines | Jefferson. |
| Robinson Brick & Tile Co | Box 5243<br>Denver, CO 80217 | do | Douglas, Elbert, El Paso, Jefferson. |
| Gold: | | | |
| Silver State Mining Corp.[2] | Box 127<br>Victor, CO 80860 | Mine and mill | Teller. |
| Standard Metals Corp.[3] | Box 247<br>Silverton, CO 81433 | do | San Juan. |
| Gypsum: | | | |
| Genstar Building Materials Co | 1153 State Hwy. 120<br>Florence, CO 81226 | Mine and plant | Fremont. |
| Iron ore: | | | |
| Pitkin Iron Corp | 105 West Adams St.<br>Chicago, IL 60603 | Mine | Pitkin. |
| Lead: | | | |
| ASARCO Incorporated[4] | Box 936<br>Leadville, CO 80461 | Mine and mill | Lake. |
| Lime: | | | |
| The Great Western Sugar Co | 1530 16th St.<br>Denver, CO 80217 | Plants | Larimer, Logan, Morgan, Sedgwick, Weld. |
| Molybdenum: | | | |
| AMAX Inc.[5] | 13949 West Colfax Ave.<br>Golden, CO 80401 | Mines and mills | Clear Creek and Lake. |
| Peat: | | | |
| Universal Peat Co | 1557 South Ingalls St.<br>Lakewood, CO 80226 | Bog | Park. |
| Perlite: | | | |
| Grefco Inc | Box 308<br>Antonito, CO 81120 | Plant | Conejos. |
| Persolite Products Inc | Box 105<br>Florence, CO 81226 | Mine and plant | Custer and Fremont. |
| Sand and gravel: | | | |
| Castle Concrete Co | Box 2379<br>Colorado Springs, CO 80901 | do | El Paso and Pueblo. |
| Albert Frei and Sons | 11521 Brighton Rd.<br>Henderson, CO 80640 | Pits and plants | Adams, Clear Creek, Garfield. |
| Cooley Gravel Co | Box 5485TA<br>Denver, CO 80217 | do | Adams, Arapahoe, El Paso. |
| Flatiron Sand and Gravel Co | Box 229<br>Boulder, CO 80306 | do | Boulder, Eagle, Larimer, Summit, Weld. |
| Koppers Co. Inc | Box 21649<br>Denver, CO 80221 | do | Arapahoe, Boulder, El Paso, Jefferson, Larimer, Pueblo, Weld. |

See footnotes at end of table.

## Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Sand and gravel —Continued | | | |
| Mobile Pre-Mix Concrete Inc.[1] | Box 5183TA<br>Denver, CO 80217 | Pits and plants | Adams, Douglas, Eagle, Garfield, Jefferson, Larimer, Moffat, Routt, Weld. |
| Zigan Sand and Gravel Inc | 1875 West Dartmouth<br>Englewood, CO 80110 | do | Adams and Weld. |
| Silver: | | | |
| Hecla Mining Co.[6] | Box D<br>Leadville, CO 80461 | Mine and mill | Lake. |
| Homestake Mining Co.[7] | Box 98<br>Creede, CO 81130 | do | Mineral. |
| Vanadium: | | | |
| Union Carbide Corp., Umetco Minerals Corp. | Old Ridgebury Rd.<br>Danbury, CT 06817 | Mines and mills | Garfield, Mesa, Montrose, San Miguel. |

[1] Also stone.
[2] Also silver.
[3] Also copper, lead, silver, and zinc.
[4] Also copper, gold, silver, and zinc.
[5] Also pyrites, tin, and tungsten.
[6] Also copper, gold, lead, and zinc.
[7] Also copper, lead, and zinc.

# The Mineral Industry of Connecticut

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, for collecting information on all nonfuel minerals.**

### By L. J. Prosser, Jr.,[1] and R. J. Altamura[2]

Nonfuel mineral production in Connecticut in 1984 was valued at a record high for the second consecutive year. All the nonfuel minerals mined in Connecticut were industrial minerals with crushed stone and sand and gravel accounting for the largest production increases in 1984 compared with 1983 levels. Enhanced production of these commodities was attributed to increased nonresidential construction, reported to be about 20% greater than in 1983, and to road construction, up nearly 122%.

Nationally, Connecticut continued to rank second in feldspar production. In the six-State New England region, the State accounted for about 26% of the total value of nonfuel mineral production, ranking second in output of crushed stone and clays.

**Table 1.—Nonfuel mineral production in Connecticut[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays ---------- thousand short tons-- | 86 | $515 | 99 | $565 |
| Lime ---------- do---- | 5 | 400 | W | W |
| Sand and gravel (construction) ---------- do---- | [e]5,000 | [e]17,900 | 6,718 | 22,817 |
| Stone: |  |  |  |  |
| Crushed ---------- do---- | 7,692 | 45,890 | [e]8,300 | [e]49,400 |
| Dimension---------- do---- | 18 | 1,028 | [e]18 | [e]1,080 |
| Combined value of feldspar, gem stones, mica (scrap), sand and gravel (industrial), and value indicated by symbol W ---------- | XX | 5,480 | XX | 5,834 |
| Total ---------- | XX | 71,213 | XX | 79,696 |

[e]Estimated. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

### Table 2.—Value of nonfuel mineral production in Connecticut, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Fairfield | $1,003 | (2) | |
| Hartford | W | W | Stone (crushed), clays. |
| Litchfield | 2,788 | $4,125 | Stone (crushed), lime. |
| Middlesex | 5,117 | W | Feldspar, sand and gravel (industrial), mica, clays. |
| New Haven | 2,479 | W | Stone (crushed), stone (dimension). |
| New London | W | W | Sand and gravel (industrial). |
| Tolland | 2,058 | W | Stone (dimension). |
| Windham | 1,333 | W | Stone (crushed), stone (dimension). |
| Undistributed[3] | 7,402 | 49,187 | |
| Sand and gravel (construction) | XX | [e]17,900 | |
| Stone: | | | |
| Crushed | [e]32,700 | XX | |
| Dimension | [r] [e]923 | XX | |
| Total[4] | [r]55,802 | 71,213 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] County distribution for crushed and dimension stone (1982) and construction sand and gravel (1983) is not available.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4] Data do not add to totals shown because of independent rounding.

### Table 3.—Indicators of Connecticut business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 3,126 | 3,139 | 3,154 |
| Total civilian labor force | do | 1,575.7 | 1,612.0 | 1,672.0 |
| Unemployment | do | 120.3 | 97.0 | 77.0 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 1.7 | 1.5 | 1.4 |
| Metal mining[2] | do | .2 | .1 | NA |
| Nonmetallic minerals except fuels[2] | do | .8 | .8 | NA |
| Manufacturing total | do | 418.8 | 403.4 | 418.6 |
| Primary metal industries | do | 17.7 | 16.3 | 16.1 |
| Stone, clay, and glass products | do | 6.4 | 5.8 | NA |
| Chemicals and allied products | do | 21.5 | 22.0 | 22.4 |
| Petroleum and coal products | do | .5 | .4 | NA |
| Construction | do | 49.4 | 54.1 | 61.0 |
| Transportation and public utilities | do | 61.8 | 61.7 | 66.5 |
| Wholesale and retail trade | do | 303.3 | 312.6 | 333.8 |
| Finance, insurance, real estate | do | 113.7 | 117.4 | 123.1 |
| Services | do | 301.5 | 313.8 | 335.5 |
| Government and government enterprises | do | 179.6 | 182.0 | 185.8 |
| Total | do | 1,429.8 | 1,446.5 | 1,525.7 |
| Personal income: | | | | |
| Total | millions | $43,689 | $46,853 | $52,221 |
| Per capita | | $13,978 | $14,928 | $16,556 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 40.5 | 41.3 | 42.5 |
| Total average hourly earnings, production workers | | $8.23 | $8.76 | $9.22 |
| Earnings by industry: | | | | |
| Farm income | millions | $118 | $109 | $137 |
| Nonfarm | do | $30,061 | $32,644 | $36,607 |
| Mining total | do | $73 | $61 | $62 |
| Nonmetallic minerals except fuels | do | $21 | $23 | $25 |
| Oil and gas extraction | do | NA | $11 | $12 |
| Manufacturing total | do | $10,747 | $11,098 | $12,211 |
| Primary metal industries | do | $494 | $488 | $529 |
| Stone, clay, and glass products | do | $153 | $154 | $157 |
| Chemicals and allied products | do | $727 | $800 | $860 |
| Petroleum and coal products | do | $24 | $21 | $9 |
| Construction | do | $1,342 | $1,649 | $1,934 |
| Transportation and public utilities | do | $1,641 | $1,780 | $2,010 |
| Wholesale and retail trade | do | $4,591 | $4,957 | $5,561 |
| Finance, insurance, real estate | do | $2,529 | $2,898 | $3,281 |
| Services | do | $5,667 | $6,426 | $7,326 |
| Government and government enterprises | do | $3,380 | $3,695 | $4,107 |

See footnotes at end of table.

## Table 3.—Indicators of Connecticut business activity —Continued

| | 1982r | 1983 | 1984p |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 10,330 | 15,672 | 17,890 |
| Value of nonresidential construction millions | $613.6 | $655.2 | $789.1 |
| Value of State road contract awards do | $67.1 | $149.4 | $331.4 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 624 | 641 | 775 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $55.8 | $71.2 | $79.7 |
| Value per capita | $18 | $23 | $25 |

pPreliminary. rRevised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

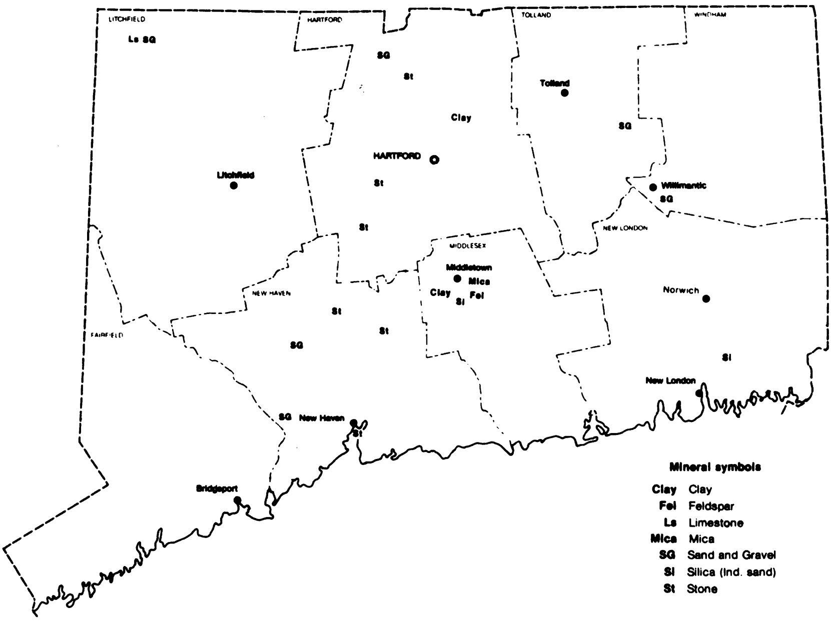

Figure 1.—Principal mineral producing localities in Connecticut.

**Trends and Developments.**—Connecticut was selected as the site for introducing a new technological concept in steel manufacturing in the United States. The Korf Group announced plans to invest $50 million for the formation of Connecticut Steel Corp. at the site of the defunct Yale Steel Corp. in Wallingford. The new operation, termed a micromill, was expected to begin limited production in the spring of 1985 and is to be equipped with an energy optimizing furnace (EOF) instead of the electric arc furnaces used predominantly in minimills in the United States. Energy costs are reduced because the EOF uses low-sulfur coal fines, coke breeze or charcoal fines, and oxygen, resulting in an estimated savings of $25 to $30 per ton.[3] This type of operation has proven successful in Brazil; Connecticut Steel will become the first U.S. operation to utilize this technology. The company expects to produce 200,000 tons of finished steel products and to convert 60,000 tons of wire rod into welded wire mesh and other wire products by 1986 when the mill is fully operational. Total employment of about 300 is expected.

The State's copper and brass fabricating industries, for the most part, agreed with the rejection of the U.S. copper producers' petition to the Federal Government for relief from imports of refined and blister copper. The decision was based primarily on the contention that import restrictions would raise the price of copper for U.S. fabricators and that more jobs would be lost than gained by imposing the restrictions recommended by the International Trade Commission.

The New Haven Terminal, which imported 140,000 tons of foreign copper in 1983 and 150,000 tons in 1984, also benefited from the decision. Most of the copper received at the New Haven Terminal, which annually handles about 30% of the total U.S. refined copper imports, was mined in Chile with lesser amounts received from Peru, the Republic of South Africa, and Zaire. The copper is purchased by about 50 fabricators in Connecticut and throughout the Northeast.

Phelps Dodge Corp., 1 of 11 domestic copper producers that petitioned for the restrictions, expressed disappointment with the decision, although it was not expected to adversely affect 1985 production at its continuous cast copper rod mill at Norwich. This mill, using both foreign and domestic copper, operated at near capacity of 180,000 tons per year in 1984.

**Legislation and Government Programs.**—The enactment of a $5.5 billion, 10-year program to improve the State's infrastructure highlighted the 1984 legislative session. The program involves massive repairs and rehabilitation of Connecticut's highways, primary and secondary roads, mass transit system, and bridges. Of the $5.5 billion, $2.1 billion will be generated by the State through an increase in the gasoline tax and $3.4 billion in Federal funding. During the 10-year program, gasoline taxes will be hiked by 9 cents per gallon, and highway user fees will be increased substantially. An estimated 20,000 tons of aggregate is required per million dollars of construction cost, based on production data reported to the U.S. Bureau of Mines and methodology applied by the Federal Highway Administration to determine aggregate usage factors.[4]

Other legislation that broadly affected segments of the State's varied industries is described in capsule summary form in the "Classified Index of Legislation Enacted by the 1984 General Assembly." The index lists measures by bill number and includes amendments to existing statutes.[5]

The Natural Resources Center and the Geological and Natural History Survey continued programs to collect, interpret, and disseminate information on Connecticut's natural resources. During the year, the Connecticut Survey worked on development of a statewide geographic information system that included, among others, data bases for geology, soils, drainage basins, and land use. Demonstration of the system's capabilities for a two-quadrangle pilot area is planned for the 1985 American Association of State Geologists meeting, which will be held in Connecticut for the first time since 1911.

The Connecticut Survey continued bedrock and surficial mapping programs in cooperation with the U.S. Geological Survey (USGS). A new State bedrock geological map was expected to be published, and a surficial materials map open filed in June 1985. Vibracoring in Long Island Sound and deep bedrock drilling in the Moodus area were completed. Lineament mapping utilizing a State mozaic of the new side-looking airborne radar imagery acquired by the USGS was scheduled to be completed and open filed in 1985.

A layman's guide to the geology of Connecticut, "The Face of Connecticut," which explains the geology to the general public, was expected to be published in 1985. In addition, an evaluation was under way to better understand the State's mineral resources in light of current trends in mineral use. A computerized bedrock well data information project for systematic examination of geographic and hydrogeologic parameters continued.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Clays.**—In 1984, two companies mined common clay for use in brick manufacture, one at East Windsor Hills, Hartford County, and the other at Middletown, Middlesex County. Output of 99,000 tons of clay reflected improved demand for brick by the housing and construction industries. Both the 1983 output of 86,000 tons and the 1984 total were significantly improved over the 1982 production of 56,000 tons.

**Feldspar.**—In 1984, feldspar was mined in six States, led by North Carolina, which accounted for 72% of the U.S. total, followed by Connecticut. Domestic production in 1984 of 710,000 tons was the same as the 1983 level; Connecticut's output declined 7% (company data is proprietary). In Connecticut, The Feldspar Corp. mined feldspar from pegmatites at the White Rocks (Middletown) and Hale (Portland) Quarries. The ore was ground and concentrated at a plant in Middletown, Middlesex County. The feldspar was beneficiated by froth flotation and used by the glass and ceramic industries.

Feldspar production remained capital intensive; energy and labor costs, particularly in Connecticut, have increased at higher rates than the increase in feldspar prices, resulting in a reduced profit margin. Use of nepheline syenite produced in Canada as a substitute for feldspar in the manufacture of glass and ceramics and the shift toward plastic bottles continued to affect demand. Also, enactment of bottle deposit legislation in the past few years in Connecticut, Maine, Massachusetts, New York, and Vermont, all of which are located in the firm's Connecticut operations market area, has resulted in increased glass recycling, thus lowering the need for feldspar as a raw material.

**Gem Stones.**—Interest was rekindled in the old Roebling Mine near New Milford, Litchfield County. When opened in 1880, the mine was worked for feldspar, and in 1896, for gem stones. In 1936, more than 1 ton of beryl was mined. Recovery of beryl, including aquamarine, emerald, and heliodor varieties, could be expected should attempts at reopening the mine prove successful.

Individual collectors and mineral clubs recovered gem stones, both precious and semiprecious, and mineral specimens from quarries and mine dumps. Gem stones are typically collected from rare-metal pegmatites and from hydrothermal mineralization.

**Lime.**—The State's only lime manufacturer, Pfizer Inc., ceased production at its Canaan plant in the first quarter of 1984. A minor amount of lime was sold in 1984; as recently as 1979, the firm produced 33,000 tons of lime. The closing reduced the number of lime plants in the six-State New England region to two, both in western Massachusetts. Pfizer continued quarrying limestone and manufacturing calcium metal at Canaan.

**Mica.**—The Feldspar Corp. recovered crude mica as a byproduct of feldspar mining operations in Middletown, Middlesex County. Production was about the same as that of 1983. The mica was marketed as a filler and as an additive in well drilling mud.

**Sand and Gravel (Construction).**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

Production increased for the second consecutive year after having declined each year from 1978 through 1982. Although output increased to 6.7 million tons in 1984, that total was well below the record high 11 million tons produced in 1978. Production, value, and unit price data for construction sand and gravel, 1975-84, were as follows:

| Year | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| 1975 | 4,900 | $10,040 | $2.05 |
| 1976 | 6,414 | 12,978 | 2.02 |
| 1977 | 8,543 | 18,316 | 2.14 |
| 1978 | 10,944 | 25,417 | 2.32 |
| 1979 | 9,990 | 23,612 | 2.36 |
| 1980 | 7,103 | 18,692 | 2.63 |
| 1981[e] | 6,500 | 18,100 | 2.78 |
| 1982 | 4,887 | 16,237 | 3.32 |
| 1983[e] | 5,000 | 17,900 | 3.58 |
| 1984 | 6,718 | 22,817 | 3.40 |
| Average | 7,100 | 18,411 | 2.59 |

[e]Estimated.

In 1978, production was reported from 145 pits; in 1984, the number dropped to 84. There are 169 towns in Connecticut, most of which regulate the local sand and gravel operations. As a result, conditions in the State's sand and gravel industry that regard zoning, blasting, transporting, and reclaiming are constantly changing. A sampling of activities in Connecticut's construction sand and gravel industry for 1984 is given in table 5.

### Table 4.—Connecticut: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand) short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 731 | $3,082 | $4.22 |
| Plaster and gunite sands | 12 | 82 | 6.92 |
| Concrete products | 29 | 104 | 3.58 |
| Asphaltic concrete | 332 | 1,150 | 3.46 |
| Road base and coverings | 493 | 1,769 | 3.59 |
| Fill | 543 | 1,393 | 2.57 |
| Snow and ice control | 325 | 1,001 | 3.08 |
| Railroad ballast | 2 | 4 | 1.82 |
| Other[1] | 4,251 | 14,233 | 3.35 |
| Total or average | 6,718 | [2]22,817 | 3.40 |

[1] Includes roofing granules and other unspecified uses.
[2] Data do not add to total shown because of independent rounding.

### Table 5.—Connecticut: Activities in the construction sand and gravel industry

| County | Number of pits[1] |  | Town | Activity |
|---|---|---|---|---|
|  | 1982 | 1984 |  |  |
| Fairfield | 6 | 6 | Brookfield | Mining permit extended for D.B.D. Inc.'s North Mountain Rd. pit, estimated output of 200,000 cubic yards per year. |
| Hartford | 23 | 14 | Burlington | Town approved 2-year permit allowing R. Poglitsch and D. Provost to mine 63,000 cubic yards at South Main St. site. |
|  |  |  | East Windsor | Town and Manchester Sand & Gravel Co. seeking permanent injunction to keep South Windsor from enforcing new ordinance prohibiting heavy trucks from using 6 of its streets. |
|  |  |  | Manchester | Operating permit of P. Lombardo expired and bond revoked at Hillstown Rd. pit. Zoning Commission claims grading and filling problems not corrected. |
| Litchfield | 14 | 13 | Canaan | Resident seeking ordinance changes to control mining operations of Connecticut Sand & Stone Corp. on Clayton Rd. |
|  |  |  | New Milford | Zoning Commission ruled that 3,000 cubic yards must be mined annually for operation to be considered active. The number of mines in the town dropped from 20 to 6 since 1980. |

See footnotes at end of table.

## Table 5.—Connecticut: Activities in the construction sand and gravel industry —Continued

| County | Number of pits[1] |  | Town | Activity |
|---|---|---|---|---|
|  | 1982 | 1984 |  |  |
| Middlesex | 7 | 6 | Killingsworth | Shoreline Washed Sand & Stone Co. closed its sand and gravel pit and sold it to unnamed new owners. The company's 5-year permit expired in January 1984. New owner will be required to submit a new application and would be limited to mining 10,000 cubic yards per year under revised zoning regulations adopted in 1982. |
|  |  |  | Middlefield | Xenelis Construction Co. received a 1-year lease to mine the Strickland sand and gravel pit. Xenelis will pay the town $1 per cubic yard mined plus 25 cents per cubic yard for a performance bond. |
|  |  |  | Westbrook | Connecticut Valley Sand & Stone Co.'s application to mine 1.7 million cubic yards of sand and gravel from a 98-acre site was rejected. |
| New Haven | 9 | 11 | Beacon Falls | Hamden Sand & Gravel Co. ordered to cease operations by zoning board but continued to operate while appealing the decision. D & J Quarry order ed to cease and desist until returning gravel mining pit to original contours.<br>O&G Industries Inc. was approved to mine and process sand and gravel at 3 locations. |
|  |  |  | Hamden | Angelo Pettorini Trustees permit renewed for 1985. |
| New London | 11 | 11 | Franklin | Planning and Zoning Commission required all 5 of the town's sand and gravel operations to apply for new permits. Permits are required for operations that remove more than 10 cubic yards per year. |
|  |  |  | Groton | Zoning Commission approved a 2-year permit for W. Carroll to mine 82,250 cubic yards but was sued by a residents' group to overturn the decision. |
| Tolland | 10 | 14 | Mansfield | Town denied application by DeSiato Sand & Gravel Co. to expand its operations to include a ready-mixed concrete plant. |
|  |  |  | Stafford | Town denied a permit to G. Bruzzi for mining sand and gravel. |
| Windham | 8 | 9 |  |  |
| Total | 88 | 84 |  |  |

[1] Reporting production to the U.S. Bureau of Mines.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Hartford and New Haven Counties accounted for most of the State's output with lesser amounts produced in Litchfield and Windham Counties. The dominant crushed stone produced is traprock quarried from Mesozoic lava flows and shallow intrusions which are found in the central part of the State. Located in a belt extending from west-central Hartford County to north-central New Haven County are 11 of the State's 12 active traprock quarries.

*Dimension.*—Output in 1984 of 17,578 tons (208,000 cubic feet) was about the same as that of 1983. Dimension stone was produced at six quarries, one in New Haven, two in Tolland, and three in Windham Counties. The stone was sold primarily as rough blocks, irregular-shaped stone, and as rubble.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] Geologist, State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, Hartford, CT.

[3] The quantities used throughout this chapter are short tons unless otherwise specified.

[4] Block, F. Estimated Impact of the Surface Transportation Assistance Act of 1982 on the Demand for Road Construction Aggregate. BuMines Minerals and Materials, A Bimonthly Survey, June-July 1983, pp. 35-43.

[5] Greater Hartford Chamber of Commerce. The Classified Index of Legislation Enacted by the 1984 General Assembly. State Legislation Committee, July 1984, 22 pp. For more information, write to the Greater Hartford Chamber of Commerce, 250 Constitution Plaza, Hartford, CT 06103.

### Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays: | | | |
| The Michael Kane Brick Co | 654 Newfield St.<br>Middletown, CT 06457 | Pit and mill | Middlesex. |
| K-F Brick Co | Box 375<br>East Windsor Hill, CT 06028 | Mine and mill | Hartford. |
| Feldspar: | | | |
| The Feldspar Corp.[1] [2] | Box 99<br>Spruce Pine, NC 28777 | Mines and plant | Middlesex. |
| Sand and gravel: | | | |
| Construction: | | | |
| Dan Beard Inc | Box 71, Mary St.<br>Shelton, CT 06484 | Pit and plant | New Haven. |
| Connecticut Sand & Stone Corp | 7 West Main St.<br>Plainville, CT 06062 | Pit and plants | Hartford and Litchfield. |
| D.B.D. Inc | Box 62, Sandcut Rd.<br>Brookfield, CT 06805 | Pit and plant | Fairfield. |
| Roncari Industries Inc.[3] | 1776 South Main St.<br>East Granby, CT 06026 | do | Hartford. |
| Tilcon Inc.[3] | Box 67, 909 Foxen Rd.<br>North Branford, CT 06471 | Pits and plants | Do. |
| Industrial: | | | |
| Ottawa Silica Co., Connecticut Div | Box 577<br>Ottawa, IL 61350 | Pit and plant | New London. |
| Stone: | | | |
| Crushed and broken: | | | |
| Edward Balf Co | Box 11190<br>Newington, CT 06111 | Quarry | Hartford. |
| O&G Industries Inc | 23 Casson Ave.<br>Torrington, CT 06790 | Quarries | Litchfield and New Haven. |
| York Hill Trap Rock Quarry Co | Westfield Rd.<br>Meriden, CT 06450 | Quarry | New Haven. |
| Dimension: | | | |
| Box Mountain Quarries Inc | 1111 Mott Hill Rd.<br>South Glastonbury, CT 06073 | do | Tolland. |
| Castellucci & Sons Inc | West River St.<br>Providence, RI 02904 | do | New Haven. |
| Wayne C. Williams General Construction Inc. | RFD 1, Conklin Rd.<br>Stafford Springs, CT 06076 | do | Tolland. |

[1] Also crude mica.
[2] Also industrial sand.
[3] Also traprock.

# The Mineral Industry of Delaware

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Delaware Geological Survey for collecting information on all nonfuel minerals.**

## By William A. Bonin[1]

In May 1984, greensand joined construction sand and gravel and magnesium compounds as the only mineral commodities produced in Delaware. The value of magnesium compounds, which are extracted from seawater, is excluded from the State's total to prevent disclosure of company proprietary data. Elemental sulfur was recovered as a nondiscretionary byproduct at a petroleum refinery, which also produced sulfuric acid and petroleum coke. Chrome ore, gypsum, ilmenite, magnesium oxide, and manganese ore were shipped into the State for processing into higher value-added products. Slag was processed at the State's only steel mill.

**Table 1.—Nonfuel mineral production in Delaware[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Greensand thousand short tons | -- | -- | 1 | $18 |
| Sand and gravel (construction) do | [e]1,400 | [e]$3,200 | 1,003 | 2,795 |
| Total[2] | XX | 3,200 | XX | 2,813 |

[e] Estimated. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Partial total; excludes the value of magnesium compounds, which must be concealed to avoid disclosing company proprietary data.

## Table 2.—Indicators of Delaware business activity

| | | 1982 | 1983 | 1984 |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 600 | 606 | 613 |
| Total civilian labor force | do | 298 | 296 | 308 |
| Unemployment | do | 25 | 24 | 19 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | .1 | .1 | .1 |
| Manufacturing total | do | 67.9 | 68.2 | 70.5 |
| Primary metal industries | do | 1.9 | 1.7 | 1.8 |
| Stone, clay, glass products[1] | do | .8 | .8 | NA |
| Chemicals and allied products | do | 31.8 | 30.8 | 31.7 |
| Petroleum and coal products[1] | do | 1.2 | 1.2 | NA |
| Construction | do | 15.4 | 16.1 | 16.9 |
| Transportation and public utilities | do | 11.7 | 11.9 | 12.1 |
| Wholesale and retail trade | do | 56.5 | 58.3 | 62.6 |
| Finance, insurance, real estate | do | 13.9 | 15.5 | 17.4 |
| Services | do | 49.9 | 52.6 | 57.7 |
| Government and government enterprises | do | 43.8 | 43.4 | 43.4 |
| Total | do | 259.2 | 266.1 | [2]280.6 |
| Personal income: | | | | |
| Total | millions | $7,084 | $7,538 | $8,383 |
| Per capita | | $11,810 | $12,422 | $13,685 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 40.6 | 41.9 |
| Total average hourly earnings, production workers | | $8.64 | $9.19 | $9.30 |
| Earnings by industry: | | | | |
| Farm income | millions | $108 | $138 | $183 |
| Nonfarm | do | $5,435 | $5,837 | $6,335 |
| Mining total | do | $5 | $5 | $5 |
| Manufacturing total | do | $2,117 | $2,263 | $2,461 |
| Primary metal industries | do | W | W | W |
| Stone, clay, glass products | do | $15 | $18 | $21 |
| Chemicals and allied products | do | $1,258 | $1,295 | $1,386 |
| Petroleum and coal products | do | $60 | $65 | $70 |
| Construction | do | $352 | $366 | $380 |
| Transportation and public utilities | do | $303 | $328 | $345 |
| Wholesale and retail trade | do | $713 | $744 | $814 |
| Finance, insurance, real estate | do | $257 | $314 | $368 |
| Services | do | $864 | $952 | $1,041 |
| Government and government enterprises | do | $812 | $851 | $903 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 2,968 | 3,648 | 4,363 |
| Value of nonresidential construction | millions | $140.7 | $136.6 | $227.6 |
| Value of State road contract awards | do | $68.8 | $64.9 | $60.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 161 | 154 | 175 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $3.2 | $3.2 | $2.8 |
| Value per capita | | $5 | $5 | $5 |

NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[2] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

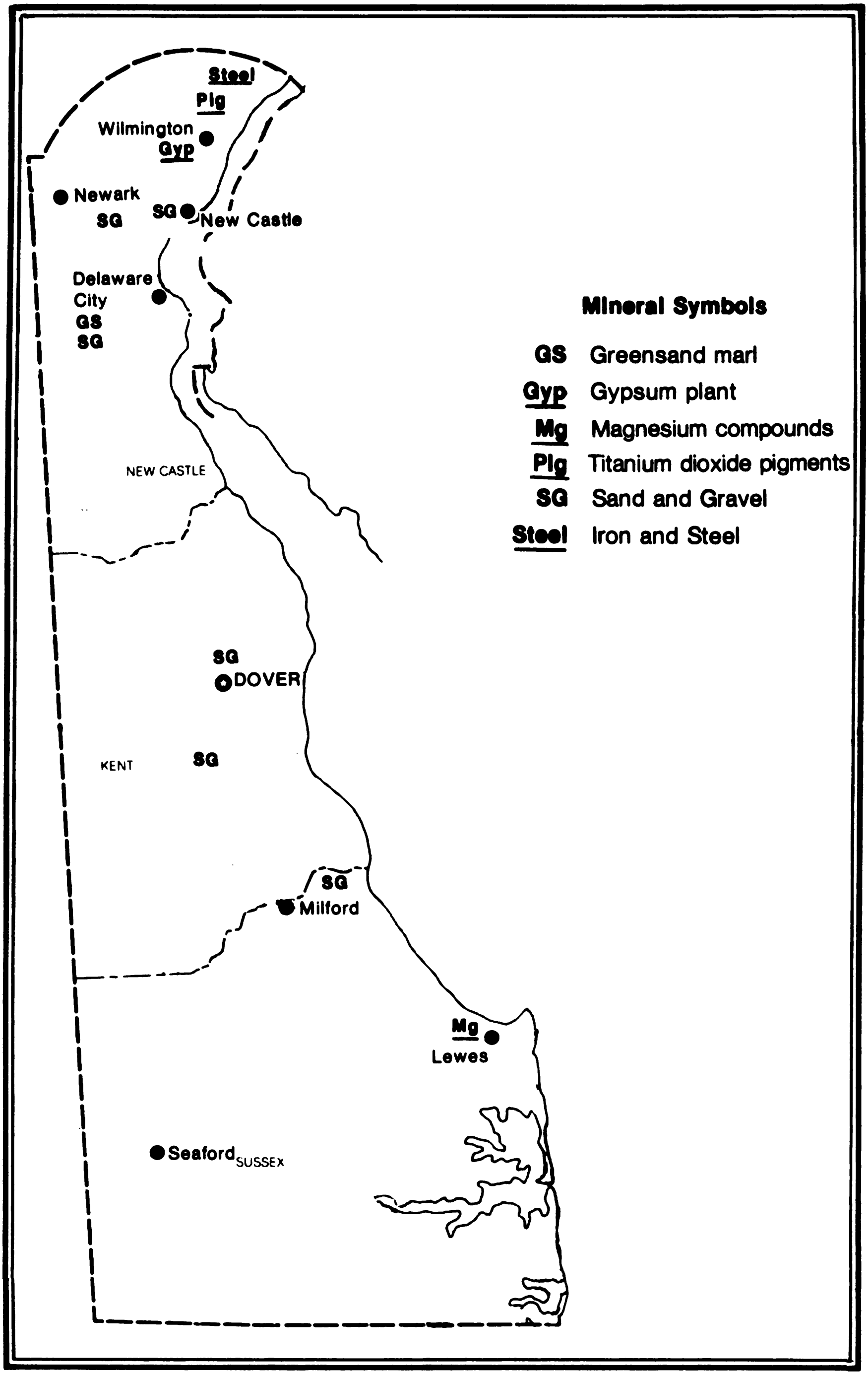

Figure 1.—Principal mineral producing localities in Delaware.

**Trends and Developments.**—The State's construction industry continued to rely heavily on shipments of construction aggregates from neighboring Maryland and southeastern Pennsylvania as evidenced by the significant decrease in production of construction sand and gravel despite the increased construction activity in 1984. Also, Delaware joined New Jersey as the only domestic producers of greensand. This material is an unconsolidated sediment of the coastal plain that is rich in glauconite, a hydrous iron-potassium silicate. It is used principally as a filter medium for the removal of iron and manganese from drinking water supply systems. Delaware's production was shipped to Pennsylvania, where it was processed for marketing as a slow release potash fertilizer and soil conditioner.

Nonfuel minerals and materials received at the Port of Wilmington in fiscal year (FY) 1984 (ending June 30) included alumina, chrome ore, dolomite, gypsum, manganese, magnesium oxides, perlite, salt, sulfur, aluminum, iron and steel, and lead. Imports of crude gypsum, the highest tonnage dry bulk commodity received in FY 1984, were 308,456 short tons, a 44% increase over FY 1983 shipments. Iron and steel imports in FY 1984 totaled 204,721 short tons, a 58% increase over that of FY 1983. The only dry bulk commodity to be exported during the year was petroleum coke at 205,782 short tons, down 34% from that of FY 1983.

In comparison with last year's figures, the port performed exceptionally well during FY 1984. Total revenues increased 8% to $9.2 million; total tonnage increased 29% to 2.8 million short tons; and container tonnage increased 45% to 257,000 tons. The overall value of commodities increased by an impressive 17% to $640 million. Also during FY 1984, nearly one-half of the port's acreage was designated as a Foreign Trade Zone. Such designation, when activated by importers, can provide economic advantages by way of financial relief on export-import duties.

**Legislation and Government Programs.**—The Delaware Geological Survey (DGS) continued programs in offshore oil and gas potential, geologic mapping, ground water availability and quality, cartographic information, landfills, and geologic hazards. Funds were provided by the U.S. Department of the Interior's Minerals Management Service in a cooperative agreement with the Association of American State Geologists for the studies by the DGS that will focus on geologic framework of oil and gas potential offshore Delaware Bay. Economic geology projects of the DGS during 1984 included investigations on uses of glauconite and advisement on State and county "mining laws."

New or expanded programs of the DGS in 1984 included initiation of a geologic atlas series to provide all available earth sciences-related data for each quadrangle in the State, funding of two new seismic stations in the Wilmington area to monitor earthquakes, and expansion of the cartographic information program. During FY 1984, the DGS drilled 52 test holes, which provided 1,100 feet of penetration for new geologic information.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Greensand.**—In May, Contractors Sand & Gravel Co. Inc. began producing greensand from the floor of its Mount Pleasant sand and gravel pit 4 miles north of the Middletown-Odessa area. Through December, Zook & Ranck Inc. trucked 1,424 short tons of the glauconite sand at $13.00 per ton f.o.b. to its processing facility in Gap, PA, about 50 miles north of the Delaware pit. Processing included drying and screening. The slow release potash fertilizer and soil conditioner is sold in 5-, 40-, and 50-pound packages for organic gardening and home use and marketed throughout the United States, including Hawaii and Alaska, under the trade name "Jersey Greensand." About 10% of the product is sold in bulk to the local farming communities, which prefer natural-organic fertilizers. Prior to Delaware's entry into greensand production, Inversand Co. in Clayton, NJ, had been the sole, recent domestic producer.

**Gypsum (Calcined).**—Georgia-Pacific Corp.'s (G-P) Gypsum Div. at Wilmington calcined imported Nova Scotian crude gypsum and manufactured wallboard and "gypcrete," a floor underlayment material. The plant, which operated 168 hours weekly throughout 1983, continued at full capacity throughout 1984 to meet the increased demand in residential and commercial building construction. Value of production increased 15% with a 7% increase in output over that of 1983. The corporation operated seven wallboard plants east of the Rocky Mountains and accounted for 13% of the total domestic production.

The Gypsum Div. of G-P developed and had a patent pending on a new gypsum wallboard product designed for use in the fast-growing exterior insulation systems industry. The product, Dens-GlassTM, was scheduled for release in 1985. It will be used for exterior sheathing and application where moisture is a potential problem.

**Magnesium Compounds.**—Barcroft Co. produced a variety of pharmaceutical-grade magnesium compounds and aluminum hydroxide from Delaware Bay seawater at its specialized fine chemical manufacturing facility in Lewes, near Cape Henlopen at the entrance to Delaware Bay. In magnesium oxide equivalent, the value of production increased 18% while output increased 13% over that of 1983.

**Manganese Compounds.**—American Minerals Inc. processed imported manganese ores at its grinding plant near the Wilmington Marine Terminal. The plant shipped most of its manganese products to the face brick industry for coloring purposes; the balance was sold for animal feeds and fertilizers. Also, imported chrome ore and various grades of magnesium oxides were ground for use in refractory bricks. The company, with headquarters in Norristown, PA, operated other grinding facilities in Camden, NJ, Rosiclare, IL, and El Paso, TX.

**Sand and Gravel.**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

Reported sales in 1984 totaled 1 million short tons valued at $2.8 million, f.o.b. plant or mine; accordingly, production and value decreased 28% and 13%, respectively, below that of 1983. Delaware along with Alaska and Hawaii were the only States in which production fell below that of 1982. In 1984, production was reported from nine operations, which included two with stationary plants, four with portable plants, two pit-run operations, and one dredging operation.

**Table 3.—Delaware: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | W | W | $5.83 |
| Plaster and gunite sands | W | W | 5.27 |
| Road base and coverings | W | W | 2.54 |
| Fill | W | W | 2.04 |
| Other | 1,003 | $2,795 | 2.79 |
| Total or average | 1,003 | 2,795 | 2.79 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

**Slag—Steel.**—International Mill Service Co. processed and sold, mainly as road base material, the steel slag generated by the two electric arc furnaces at the plate mill of Phoenix Steel Corp. in Claymont. Production and sales increased 7.5% over that of 1983.

**Sulfur (Recovered).**—Elemental sulfur was recovered as a nondiscretionary byproduct of petroleum refining at the Texaco Refining & Marketing Co. in Delaware City. Production and value increased about 4% over that of 1983. The refinery, which is specifically designed to refine the less-expensive, very high-sulfur crude oil imported from Venezuela and Mexico, also produced sulfuric acid and petroleum coke. Texaco acquired the former Getty Oil Co. refinery in July 1984 when the Federal Trade Commission approved the Texaco acquisition of Getty Oil.

The production of recovered elemental sulfur at U.S. petroleum refineries increased to an all-time record high in 1984. About 82% of the sulfur consumed in the United States was converted to sulfuric acid prior to end use.

**Titanium Dioxide.**—E. I. du Pont de Nemours & Co. Inc. continued to operate one of its four domestic titanium dioxide ($TiO_2$) pigment plants in Edgemoor. The plant used the chloride process and utilized ilmenite rather than the higher cost rutile as the feedstock. It had an annual pigment capacity of 100,000 metric tons. The ilmenite was shipped from the Du Pont operations at Starke, FL, and Eneabba, Western Australia.

Production and consumption of $TiO_2$ pigments rose to a new peak for the second consecutive year, because of continued economic expansion and increased demand from the homebuilding industry. These white pigments were used primarily in the manufacture of paints, paper, and plastics. Notable were the increased consumption for paints and plastics, and the sharp decrease in consumption in paper.

## METALS

Phoenix Steel, which entered bankruptcy in 1983, continued to operate its Claymont plate mill and its pipe and tube mill in Phoenixville, PA, while searching for new financing. In 1984, while operating under court protection from its creditors under chapter 11 of the Federal Bankruptcy Act, the company was able to trim its loss from that of 1983 by about $6 million compared with an $18.6 million loss for 1983. The company, which has $143 million in liabilities and only $117 million in assets, has not posted a profit since 1981 and has accumulated operating losses since then of more than $85 million.

In October, Phoenix Steel approved, in principle, a plan that would have two private investors purchase the company. Under the plan, the steel producer would emerge in 1985 as a private company owned by the partnership with the current management and labor force remaining in place at the two plants. Final approval of the plan by a committee representing creditors' interests and by the U.S. Bankruptcy Court was unlikely before mid-1985.

**Reclaimed Metals and Materials.**—The Delaware Reclamation Project, which was managed by the Delaware Solid Waste Authority, went into commercial operation in March. The facility, just north of the Delaware Memorial Bridge at Pigeon Point, produced 6,700 short tons of ferrous metal, 1,300 short tons of glass, and 750 short tons of aluminum in 1984 from mixed municipal solid waste generated in New Castle County.

The exemption of aluminum beverage cans from Delaware's mandatory container deposit law continued to confirm the unmatched recyclability of aluminum. In 1984, Delaware consumers recycled more than 4.8 million pounds of used aluminum beverage cans. This represented about 126 million cans or approximately 60% of all aluminum beverage cans shipped statewide. Delaware, nicknamed "the First State," was also the first State to have excluded aluminum cans from its deposit law, when in January 1983, it implemented container deposit legislation. Unless extended, the exemption was scheduled to expire January 1, 1986. During the year, the Delaware Solid Waste Authority recovered another 28.5 million cans bringing the statewide total to about 155 million cans, or 73% of statewide shipments. Prior to the exemption, the State's aluminum recyling rate was estimated at 10% to 20%.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

## Table 4.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Greensand: | | | |
| Contractors Sand & Gravel Co. Inc | Box 2630<br>Wilmington, DE 19805 | Pit | New Castle. |
| Gypsum (calcined): | | | |
| Georgia-Pacific Corp., Gypsum Div | Wilmington Marine Terminal<br>Box 310<br>Wilmington, DE 19899 | Plant | Do. |
| Magnesium compounds: | | | |
| American Minerals Inc | One Montgomery Plaza<br>Suite 906<br>Norristown, PA 19401 | Plant (grinding) | Do. |
| Barcroft Co | 40 Cape Henlopen Dr.<br>Lewes, DE 19958 | Plant (pharmaceutical-fine chemical). | Sussex. |
| Sand and gravel (construction): | | | |
| Contractors Sand & Gravel Co. Inc | Box 2630<br>Wilmington, DE 19805 | Pit | New Castle. |
| Dover Equipment & Machine Co | 113 West 6th St.<br>New Castle, DE 19720 | Dredge | Kent. |
| Parkway Gravel Inc | 4048 New Castle Ave.<br>New Castle, DE 19720 | Pits | New Castle. |
| Slag, steel: | | | |
| International Mill Service Inc | Philadelphia Pike<br>Box 160<br>Claymont, DE 19703 | Plant (processing). | Do. |
| Steel: | | | |
| Phoenix Steel Corp | 4001 Philadelphia Pike<br>Claymont, DE 19703 | Mill (plate) | Do. |
| Sulfur (recovered): | | | |
| Texaco Refining & Marketing Co.[1] | Wrangle Hill Rd.<br>Delaware City, DE 19706 | Refinery (petroleum). | Do. |
| Titanium dioxide: | | | |
| E. I. du Pont de Nemours & Co. Inc.[2] | 1007 Market St.<br>Wilmington, DE 19898 | Corporate headquarters. | Do. |
| Do | Edgemoor, DE 19809 | Plant (chemical). | Do. |

[1] Also sulfuric acid and petroleum coke. Texaco acquired Getty Oil Co. in July 1984.

[2] Also zircon and foundry mixes.

# The Mineral Industry of Florida

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Florida Bureau of Geology for collecting information on all nonfuel minerals.**

**By James R. Boyle[1] and Charles W. Hendry, Jr.[2]**

The value of nonfuel mineral production in 1984 in Florida was $1.5 billion, an increase of $234.5 million over that of 1983. Although this was the second annual consecutive increase, value was still below that of the 1981 record year. Nearly all minerals produced in the State had increased outputs in 1984, resulting in the State ranking fourth nationally in value of nonfuel minerals produced. Industrial minerals accounted for substantially all of the value of Florida's mineral output. Florida ranked first in the production of peat, phosphate rock, and masonry cement; second in crushed stone and fuller's earth; and seventh in portland cement. Staurolite and zircon concentrates were produced only in Florida. Principal nonmetals, in order of value, were phosphate rock, stone, cement, sand and gravel, and clays.

Florida remained the predominant producer of phosphate rock and for the 91st consecutive year supplied more than any other State. Florida and North Carolina supplied 86.3% of the domestic phosphate rock output, with Florida supplying most of the exports.

**Table 1.—Nonfuel mineral production in Florida[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Cement: | | | | |
| Masonry thousand short tons | 313 | $19,557 | 383 | $24,624 |
| Portland do | 3,329 | 164,048 | 3,564 | 172,548 |
| Clays do | 684 | 31,566 | 772 | 34,048 |
| Gem stones | NA | 6 | NA | 6 |
| Lime thousand short tons | W | 13,881 | 171 | 9,379 |
| Peat do | 114 | 1,999 | 263 | 5,454 |
| Sand and gravel: | | | | |
| Construction do | [e]14,900 | [e]31,500 | 21,032 | 48,494 |
| Industrial do | 329 | 3,447 | 1,533 | 9,815 |
| Stone (crushed) do | 57,282 | 235,700 | [e]68,500 | [e]290,000 |
| Combined value of magnesium compounds, phosphate rock, rare-earth metal concentrate, staurolite, titanium concentrates (ilmenite and rutile), and zircon concentrate | XX | [r]774,122 | XX | 915,996 |
| Total | XX | [r]1,275,826 | XX | 1,510,364 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Florida, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Alachua | (2) | $4,813 | Stone (crushed). |
| Bay | W | (3) | |
| Brevard | W | W | Clays, stone (crushed), sand and gravel (industrial). |
| Broward | $3,041 | 21,353 | Stone (crushed). |
| Calhoun | 75 | (3) | |
| Charlotte | (2) | 2,663 | Stone (crushed). |
| Citrus | (2) | 3,201 | Do. |
| Clay | 32,069 | W | Titanium, zirconium, rutile, staurolite, clays, peat, monazite. |
| Collier | (2) | 8,753 | Stone (crushed). |
| Dade | W | 194,563 | Cement, stone (crushed). |
| Escambia | W | W | Sand and gravel (industrial). |
| Gadsden | W | W | Clays. |
| Glades | W | W | Sand and gravel (industrial). |
| Gulf | W | W | Magnesium compounds, lime. |
| Hamilton | W | W | Phosphate rock. |
| Hardee | W | W | Do. |
| Hendry | -- | 315 | Stone (crushed). |
| Hernando | W | W | Stone (crushed), cement, lime, clays. |
| Highlands | W | W | Peat. |
| Hillsborough | 81,672 | 87,060 | Phosphate rock, cement, stone (crushed), peat. |
| Jackson | (2) | 1,284 | Stone (crushed). |
| Lake | W | W | Peat, clays. |
| Lee | (2) | 12,324 | Stone (crushed). |
| Leen | 267 | (3) | |
| Levy | (2) | 4,770 | Stone (crushed). |
| Manatee | W | W | Phosphate rock, cement, stone (crushed). |
| Marion | W | 10,017 | Clays, stone (crushed), peat. |
| Monroe | (2) | 1,242 | Stone (crushed). |
| Orange | (2) | -- | |
| Palm Beach | (2) | 1,791 | Stone (crushed). |
| Pasco | (2) | 2,664 | Do. |
| Polk | W | 572,015 | Phosphate rock, stone (crushed), sand and gravel (industrial), peat. |
| Putnam | 5,670 | W | Clays, sand and gravel (industrial), peat. |
| St. Lucie | W | W | Stone (crushed). |
| Sarasota | 393 | W | Do. |
| Sumter | W | W | Lime, stone (crushed), peat. |
| Suwannee | (2) | 1,187 | Stone (crushed). |
| Taylor | (2) | W | Do. |
| Walton | W | (3) | |
| Undistributed[4] | 917,511 | 314,813 | |
| Sand and gravel (construction) | XX | [e]31,500 | |
| Stone (crushed) | [e]182,300 | XX | |
| Total | 1,222,998 | [5]1,275,826 | |

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[e] Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed stone was produced; data not available by county. Total State value is shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Florida business activity

| | 1982r | 1983 | 1984p |
|---|---|---|---|
| Employment and labor force, annual average: | | | |
| Population thousands | 10,466 | 10,742 | 10,976 |
| Total civilian labor force do | 4,746 | 4,932 | 5,099 |
| Unemployment do | 388 | 424 | 322 |
| Employment (nonagricultural): | | | |
| Mining total[1] do | 9.6 | 9.6 | 10.2 |
| Metal mining[2] do | .3 | .3 | NA |
| Nonmetallic minerals except fuels do | 8.3 | 8.2 | 8.7 |
| Oil and gas extraction[2] do | 1.2 | 1.0 | NA |
| Manufacturing total do | 456.7 | 464.3 | 502.3 |
| Primary metal industries do | 4.7 | 4.9 | 5.2 |
| Stone, clay, and glass products do | 19.5 | 20.9 | 24.3 |
| Chemicals and allied products do | 26.6 | 25.9 | 26.5 |
| Petroleum and coal products do | 1.6 | 1.7 | 1.8 |
| Construction do | 256.6 | 268.8 | 319.4 |
| Transportation and public utilities do | 229.9 | 231.4 | 242.5 |
| Wholesale and retail trade do | 998.0 | 1,037.6 | 1,114.1 |
| Finance, insurance, real estate do | 276.6 | 283.2 | 298.7 |
| Services do | 902.0 | 971.4 | 1,068.4 |
| Government and government enterprises do | 632.5 | 639.3 | 652.6 |
| Total do | 3,761.9 | 3,905.6 | 4,208.2 |
| Personal income: | | | |
| Total millions | $114,734 | $125,195 | $140,082 |
| Per capita | $10,962 | $11,655 | $12,763 |
| Hours and earnings: | | | |
| Total average weekly hours, production workers | 39.9 | 40.7 | 41.2 |
| Mining (nonmetallic minerals) | 44.8 | 46.0 | 48.0 |
| Total average hourly earnings, production workers | $7.02 | $7.33 | $7.62 |
| Mining (nonmetallic minerals) | $7.66 | $8.12 | $8.30 |
| Earnings by industry: | | | |
| Farm income millions | $1,363 | $1,415 | $1,527 |
| Nonfarm do | $68,146 | $75,558 | $84,877 |
| Mining total do | $254 | $254 | $285 |
| Metal mining do | $6 | $7 | $12 |
| Nonmetallic minerals except fuels do | $180 | $192 | $216 |
| Oil and gas extraction do | $68 | $55 | $56 |
| Manufacturing total do | $9,279 | $10,046 | $11,448 |
| Primary metal industries do | $109 | $124 | $140 |
| Stone, clay, and glass products do | $409 | $465 | $555 |
| Chemicals and allied products do | $656 | $686 | $760 |
| Petroleum and coal products do | $45 | $49 | $57 |
| Construction do | $5,271 | $5,687 | $6,810 |
| Transportation and public utilities do | $6,119 | $6,689 | $7,157 |
| Wholesale and retail trade do | $13,634 | $14,943 | $16,676 |
| Finance, insurance, real estate do | $4,665 | $5,604 | $6,286 |
| Services do | $16,176 | $18,480 | $21,237 |
| Government and government enterprises do | $12,109 | $13,159 | $14,212 |
| Construction activity: | | | |
| Number of private and public residential units authorized | 103,813 | 189,440 | 202,933 |
| Value of nonresidential construction millions | $3,257.7 | $4,109.0 | $4,994.8 |
| Value of State road contract awards do | $391.0 | $340.0 | $583.3 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 4,398 | 5,262 | 6,733 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $1,223.0 | $1,275.8 | $1,510.4 |
| Value per capita | $117 | $119 | $138 |

pPreliminary. rRevised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add owing to the inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

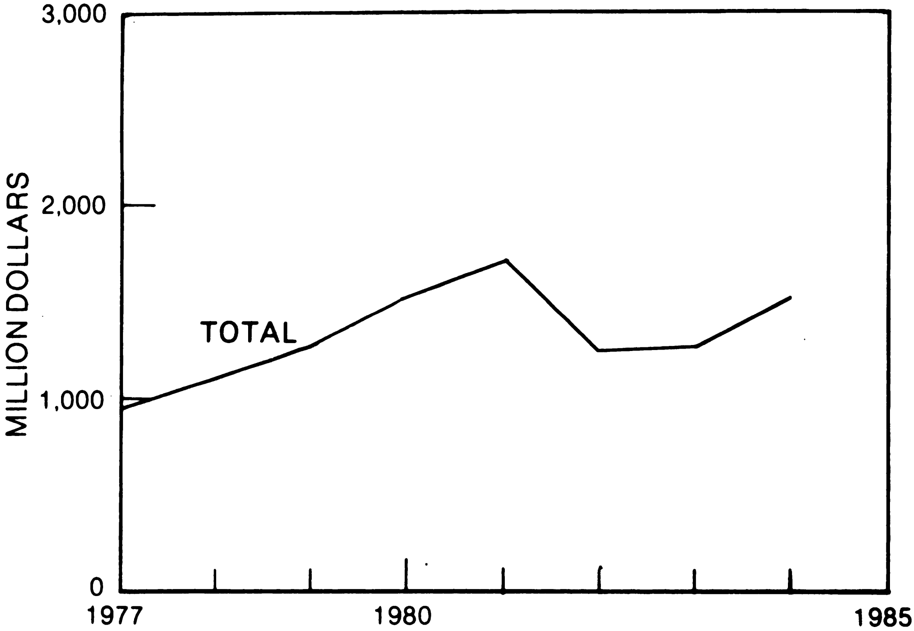

Figure 1.—Total value of nonfuel mineral production in Florida.

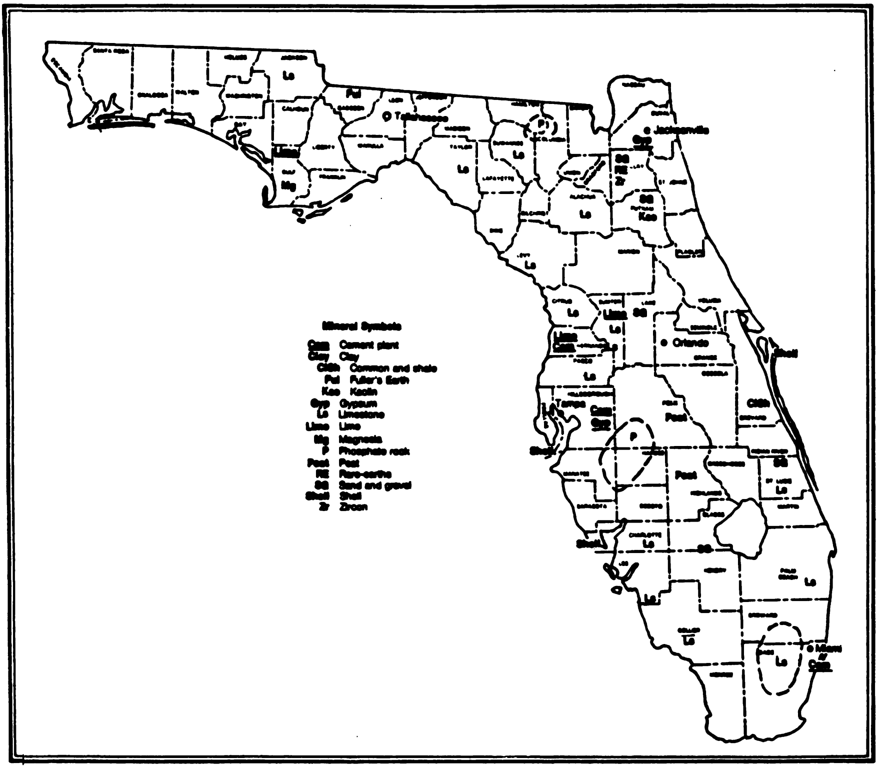

Figure 2.—Principal mineral producing localities in Florida.

**Trends and Developments.**—Florida's economy continued the strong growth that started at the end of the 1983 recession. State and local government spending to improve public facilities increased threefold in 1984 over that of 1983; surplus funds in the State treasury should stimulate more public works, thereby positively affecting nonmetal mineral output. One notable exception to the rapid growth was the phosphate mining industry, hampered by reduced demand. In 1984, however, demand increased along with exports. Alexander Grant and Co., Chicago, for the second consecutive year ranked Florida first in the Nation for business climate, stimulating both new and expanded industrial growth.[3]

The major portion of exported phosphate rock was shipped out of the Port of Tampa, which handled nearly 48 million metric tons of cargo in the fiscal year ending September 30, 1984. Exports included bulk phosphate rock (9,953,485 tons), bulk phosphate chemicals (4,933,483 tons), phosphoric acid (582,906 tons), and silica sand (21,959 tons). The Florida Phosphate Council reported that 61.5% of all cargo moved through the Port of Tampa was phosphate and phosphate-related material. The port also handled imports of aragonite (651,978 tons), down slightly from those of 1983. Aragonite was imported from The Bahamas for use in the manufacture of cement. Other imports included cement (1,468,828 tons) from Mexico, Spain, and Venezuela; cement clinker (392,609 tons); gypsum (555,021 tons); potash

(170,993 tons); liquid sulfur (631,228 tons); and about 300,000 tons of steel products. The port handled an additional 3,491,000 tons of liquid sulfur and 3,540,000 tons of coal from domestic sources. Additionally, imports of cement through Miami totaled 798,374 tons from Mexico, Spain, and Venezuela. The Tampa Port Authority purchased property at Port Sutton on Hillsborough Bay for $10.6 million. The property will be used for port expansion, particularly of bulk cargo operations. Several privately owned parcels at Port Sutton were not included.

Phosphate rock production picked up early in the year as nearly all companies operated at higher levels of output; by late 1984, several companies reduced output, citing low prices and/or low demand. Development continued at several operations even as mines closed, some permanently. The industry's anticipation of increased spring demand caused several mines and plants to be scheduled for startup early in 1985.

The concept of cogeneration caused several companies to construct units and sell excess electricity generated to public power companies. Mineral operations involved were Conserve Inc.'s 13-megawatt unit, Agrico Chemical Co.'s 7.5-megawatt unit, Gardinier Inc.'s 11-megawatt unit, and International Minerals & Chemical Corp.'s (IMC) 32-megawatt unit. Under construction were W. R. Grace & Co.'s 38-megawatt unit, IMC's new 32-megawatt unit, and Florida Crushed Stone Co.'s 125-megawatt unit.

Total oil and gas production in Florida declined for the sixth consecutive year. Oil production dropped from 19.5 million barrels in 1983 to 14.5 million barrels in 1984; gas production dropped from 23.5 billion cubic feet in 1983 to 13.9 billion cubic feet in 1984. Of the 280 wells in the south Florida and northwest Florida fields, 144 were producing, 53 were injection, 81 were shut-in, and 2 were temporarily abandoned.

**Employment.**—At yearend, Florida's unemployment rate was 5.9%, compared with 7.4% at yearend 1983. The growth was strong in the construction sector, a major user of nonmetallic minerals. Employment in construction grew five times faster than that experienced during 1983. The State's growth benefited from the basic stability of the economy. Late in the year, only the transportation-public utilities sector showed a decline in number of jobs compared with that of 1983; all other sectors showed increases.

**Legislation and Government Programs.**—The Florida Legislature passed a Wetlands Protection Act expanding the jurisdiction of the Department of Environmental Regulation (DER) and allowing DER to consider impacts of development on fish and wildlife habitat. All peat mining activities for the agricultural use of peat were exempt. In addition, the expanded dredge and fill jurisdiction did not apply to any sand, limerock, or limestone activity currently operating in compliance with DER rules. Such activities shall continue under the jurisdiction of existing regulations for a period of 10 years from October 1, 1984, provided the activity is continuous and carried out on land contiguous to mining operations in existence on or before October 1, 1984. The five water management districts in the State were required to have rules in place by October 1. The Southwest Florida Water Management District, after a legal challenge from phosphate producers, agreed to defer rules for phosphate mining for 1 year until specific rules could be adopted.

Legislation was also passed authorizing extension of the nonmandatory land reclamation program until 1995. Reclamation costs would be capped, and limitations would be placed on use of funds from the voluntary old lands program. The severance tax on phosphate rock, due to expire in 1987, was extended through 1995. Late in the year, the Governor requested that the Department of Natural Resources (DNR) draft a phosphate mining law to be presented to the 1985 legislature.

In a special session late in the year, the legislature passed and the Governor signed a bill to end the unitary tax passed in 1983. Adverse reactions by corporations prompted the change. To make the bill "revenue neutral," the State's general corporate tax was increased from 5% to 5.5%.

During the year, DNR had two outstanding nonfuel mineral leases on State lands. Vulcan Materials Co. was mining limerock in Dade County, and Radcliff Materials Co. was dredging sand and gravel in the Chattahoochee River. Vulcan paid the State a minimum of $40,000 per year, or 7 cents per short ton; Radcliff paid a $2,000 bonus plus a royalty of 30 cents per cubic yard.

The Florida Bureau of Geology continued its geologic investigations in the State. Projects under way included geology of the Pre-Punta Gorda Beds in south Florida; geology of the Cretaceous brown dolomite in south Florida; geologic parameters to pertinent waste disposal in Florida; summary of the economic minerals in Florida; geology of Madison County; studies of Florida karst, lithostratigraphy, and stratigraphy; and an overview of peat in the State. Publications during the year included "Oil Potential of the Lower Cretaceous Sunniland Formation in South Florida," "Biostratigraphy of Selected Cores of the Hawthorn Formation in Northeast and North Central Florida," "Long-Term Streamflow Stations in Florida, 1980," "Projected Public Water Supplies in Florida Through 2020," and "Wetlands in Florida."

The Florida Institute of Phosphate Research continued its funding of research activities with respect to mining and processing phosphate rock and reclamation of disturbed lands. The Institute's funding of about $5 million was directed toward chemical processing, beneficiation, reclamation, mining, and environmental studies, both inhouse and sponsored research. The studies involved utilization of phosphogypsum, reduction of slime pond areas, wetland and innovative reclamation, mining concepts, and radiation effects. The Institute has designated the high-volume use of phosphogypsum as a top priority for research. Phosphogypsum is a byproduct of the production of phosphate fertilizers.

The Florida Department of Revenue reported receipts of severance taxes during fiscal year 1984 of $86.8 million. Most of the receipts were from phosphate rock, with about $200,000 from heavy minerals. The severance tax in 1984 for phosphate rock was $2.17 per metric ton with an adjustment each calendar year based on the producers' price index.

The Federal Government enacted legislation protecting the Osceola National Forest from phosphate mining unless and until an overriding national need develops. Also designated for wilderness protection were Big Gum Swamp, Juniper Prairies Wilderness, Little Lake George Wilderness, Bradwell Bay Wilderness, Alexander Springs and Billie Bay, and Mud Swamp New River.

The U.S. Geological Survey (USGS) conducted mineral, energy, geochemical, and marine geology studies in and offshore Florida. Resource studies were conducted on oil and gas, peat, titanium, heavy minerals, and phosphate. Other studies in cooperation with the U.S. Bureau of Mines involved several Roadless Area Review and Evaluation (RARE II) areas. USGS published Professional Paper 1300, "Wilderness Mineral Potential." Included in the report prepared in cooperation with the U.S. Bureau of Mines were five areas in the State: Bradwell Bay Wilderness and Sopchoppy River Wilderness, Clear Lake Roadless Area, Farles Prairie and Buck Lake Roadless Areas, Natural Area Roadless Area, and Savannah Roadless Area.

Since 1972, the U.S. Bureau of Mines Tuscaloosa Research Center has been involved with various projects related to dewatering phosphate waste slimes, upgrading marginal ores, and developing means to improve the postmining environment. Inhouse Bureau project activity during 1984 included research on beneficiation of dolomitic phosphate ores, dewatering of waste phosphate clay slime by flocculation utilizing a field test unit, recovery of phosphate from dewatered slimes, recovery of sulfur from phosphogypsum wastes, and procedures for establishment of wetland ecosystems after mining.

Bureau publications issued during the year pertaining to the mineral industry of Florida included Bulletin 676, "Conventional Versus Developing Processes of Phosphatic Clay Disposal: A Technical Evaluation." Reports of Investigations (RI) issued included RI 8895, "Rheology of Ion-Exchanged Montmorillonite Clays," and RI 8903, "Continuous Beneficiation of Dolomitic Phosphate Ores." Information Circulars (IC) issued included IC 8980, "A Review of Phosphatic Clay Dewatering Research," and IC 8989, "Phosphate Rock Availability-World."

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Cement.**—Shipments of portland and masonry cement increased over those of 1983. Cement was the third leading commodity in value in the State. Production of masonry cement ranked first nationally, while that of portland cement ranked seventh. Increased construction activity impacted favorably on the cement industry, with both masonry and portland cement output at their highest levels in 15 years. Four companies produced portland cement at five plants; masonry cement was also produced at five plants. Daily clinker capacity of the five plants was 10,500 short tons. A fifth company operated a grinding plant to produce portland cement from imported clinker. Most of the output of both cement types was used within the State; Florida was a net importer of cement with about 2.3 million tons imported, primarily from Mexico, Spain, and Venezuela. In addition, nearly 400,000 tons of clinker was imported through the Tampa facilities. The trend is toward more imported cement and is expected to continue as long as the dollar remains strong in foreign markets. Portland cement shipments, mainly in bulk form, were made by truck and rail. Principal consumers were ready-mixed concrete contractors, building materials dealers, and concrete products manufacturers, with the remainder used by other contractors and government agencies.

Raw materials from within the State used to manufacture cement included limestone, clays, sand, and staurolite. Oolitic aragonite imported from The Bahamas was used, along with gypsum, clinker, fly ash, and iron ore, most of which was from out-of-State sources.

Ten rotary kilns were operated at the five plants—eight were wet process and two were dry process. Energy requirements in the manufacture of cement included 446 million kilowatt hours of electrical energy, along with natural gas, fuel oil, and coal.

Florida Crushed Stone started construction of its 600,000-ton-per-year cement plant at Brooksville. The facility, estimated to cost over $100 million, would be capable of producing 350,000 tons of lime per year and will include a 125-megawatt cogeneration powerplant. The clinker grinding section, along with storage silos, was scheduled for completion early in 1986, with the remainder of the cement plant and the power and lime plants scheduled for completion late in 1986. The lime plant would consist of a fluid-bed calciner and two cooling fluid beds incorporated within the boiler.

General Portland Inc. closed its 610,000-ton-per-year plant in Miami and planned to import cement from Mexico through the West Palm Beach terminal. The facility will be maintained in order to resume production if required. General signed an agreement with Eagle Cement Corp. for cement to be manufactured by Cementos Anahuac in Tamuin, Mexico. General also shut down its kiln at Tampa and planned to grind imported clinker from Mexico. The company planned to increase storage capacity, with construction to begin in 1985 and be completed by mid-1986.

Lonestar Florida Pennsuco Inc. sold its aggregate, ready-mixed concrete, and concrete block plants in Florida to Tarmac PLC of England for approximately $80 million. The plants involved are along the east coast of Florida and in the Florida Keys. Lonestar retained its interest in the Pennsuco cement plant and Stresscon prestressed concrete manufacturing operation. The four quarries purchased have a combined output of about 6.5 million tons. Lonestar acquired certain assets of Charley Toppino and Sons Inc. The operations included four ready-mixed concrete plants, a block manufacturing facility, and three construction aggregate operations.

National Portland Cement Co., which ground imported clinker, increased capacity at its Port Manatee facility to 700,000 tons per year. Cement clinker was imported mainly from Spain and France. Eastern Portland Cement Corp., a cement importer, was constructing a 40,000-ton-capacity terminal at Port Manatee. Completion was scheduled for early 1985.

**Clays.**—Clays mined in Florida included common clay, fuller's earth, and kaolin. Total clay production increased nearly 90,000 short tons, while value increased nearly $2.5 million. Common clay output and value increased over those of 1983. Common clay was produced by three companies at three pits in Clay, Hernando, and Lake Counties in the northern part of the State. The clay was used in the manufacture of cement and lightweight aggregate.

Florida ranked second nationally in output of fuller's earth with production and value increasing over those of 1983. Fuller's earth was mined by four producers at four pits in Brevard, Gadsden, and Marion Counties. Main end uses were for pet waste absorbents and oil and grease absorbents, and in fertilizers, pesticides, and saltwater drilling muds. Material mined was a montmorillonite-attapulgite product with end products shipped nationwide. Floridin Co., Quincy, began modernizing its facility in 1984. Improvements centered on material handling facilities and process controls; completion was scheduled for early in 1985.

Kaolin was produced by one company in Putnam County with output increasing over that of 1983. Florida kaolin was used in jiggering and extrusion processes where a high degree of workability was required. It has excellent suspending power and was widely used in glazes. Principal uses were electrical porcelain, whiteware, and wall tile, with major markets in the Southeast. Byproduct industrial sand was recovered for glass and other industrial uses.

**Fluorspar.**—Fluorine in the form of fluosilicic acid was recovered as a byproduct of wet-process phosphoric acid manufacture. Six companies operated facilities in the State. Fluosilicic acid was used to preduce cryolite, aluminum fluoride, and sodium silicofluoride, and in water fluoridation.

**Gypsum.**—Imported gypsum was calcined at three plants in Florida, two in Duval County and one in Hillsborough County. United States Gypsum Co., Jim Walter Corp., and National Gypsum Co. calcined gypsum in kettles, a rotary kiln, and a holoflite unit, respectively, prior to manufacture of wallboard; Florida ranked fourth nationally in manufacture of wallboard. U.S. Gypsum's plant ranked first nationally in output, while National Gypsum's plant ranked fifth. Production and value increased over those of 1983. Principal marketing area for Florida's gypsum wallboard is southern Georgia and Florida. Byproduct gypsum was recovered by Occidental Chemical Co. at its plant near White Springs; output and value increased over those of 1983. Standard Gypsum Co. imported gypsum through its facilities in Tampa.

**Lime.**—Quicklime and hydrated lime were produced in Florida, with output of both decreasing from that of 1983. Quicklime was produced by Basic Magnesia Inc., Gulf County; Chemical Lime Inc., Hernando County; and Dixie Lime & Stone Co., Sumter County. Chemical Lime also produced hydrated lime. Total lime output decreased from that of 1983, along with a decrease in unit values. Florida markets consumed significantly more lime than was produced in the State, with out-of-State producers supplying the balance. Lime was used in water purification, magnesia recovery from seawater, and paper and pulp manufacturing.

**Magnesium Compounds.**—Florida ranked second in the Nation in the recovery of magnesium compounds from seawater. Basic Magnesia, Gulf County, produced caustic-calcined magnesia and refractory-grade magnesia from seawater. Shipments and value each decreased 35% from that of 1983, indicating a stabilization in unit prices. Capacity of the Port St. Joe facility was 100,000 short tons of MgO equivalent.

**Nitrogen.**—Air Products & Chemicals Inc. produced anhydrous ammonia at its plant in Pace Junction; the plant had a capacity of 100,000 short tons per year. The Directory of Florida Industries also listed Jones Chemicals Inc., Fort Lauderdale, as having anhydrous ammonia in its product line.

**Peat.**—Florida ranked first nationally in peat sales in 1984. Reported production increased substantially over that of 1983. Fourteen companies reported production of reed-sedge and humus peat from nine counties. Most of the peat, shipped in bulk, was used for potting soils and nurseries. The Florida Bureau of Geology in a recent study identified 22 companies with peat operations in 12 counties.

**Perlite (Expanded).**—Four companies produced expanded perlite from crude ore shipped into the State. Production decreased to 20,500 short tons, while value decreased to $3.5 million. Perlite was expanded at plants in Broward, Duval, Escambia, and Indian River Counties, and was used for construction aggregate, horticultural purposes, insulation, and filler. Grefco Inc., a major producer of perlite and diatomite, purchased Chemrock Corp.'s expanded perlite operation at Jacksonville. The purchase would permit Grefco to market expanded perlite product in addition to supplying crude perlite ore.

**Phosphate Rock.**—The phosphate industry continued to be the principal mineral industry in the State, as Florida ranked first in the Nation in output of phosphate rock. Production of marketable phosphate rock in 1984 increased 16% in output and nearly 19% in value over that of 1983. Output picked up gradually late in 1983 and continued through most of 1984 as companies built up depleted inventories in anticipation of increased demand. Late in the year, several companies reduced output or closed mines, citing low prices and/or reduced demand; some companies reportedly sold fertilizer at below cost. Of the 12 companies mining phosphate rock, 8 reduced stockpile levels by yearend. Even as the industry picked up early in 1984, employment was only 11,500 compared with 14,600 in 1981. The gradual decline since 1981 has caused several companies to indicate their operations were for sale, while others were expanding capacity. Indications at yearend were mixed as new and shutdown mines announced opening early in 1985, while several plants closed. The strength of the dollar and the financial problems of farmers could have a continued dampening effect on production. Additionally, the Florida Phosphate Council reported that under present regulations a company could spend $10 million and up to 10 years to obtain the necessary permits to open a mine.

According to the Florida Phosphate Council, 1984 production was 37.9 million metric tons, a 13.5% increase over output reported by the Council in 1983. Output of major finished products was mixed as shown in the following parenthetical figures: phosphoric acid (-13.7%), triple superphosphate (+0.2%), diammonium phosphate (+61.8%), monoammonium phosphate (+63.7%), and animal feed supplements (-15.9%). Employment increased from 11,540 in 1983 to 12,500 in 1984. The Council reported that the industry paid $137 million in State and county taxes, compared with $110 million in 1983. Severance tax increased from $2.10 per ton in 1983 to $2.17 per ton in 1984. Expansion and construction costs totaled $150 million in 1984. The Council also reported that one-third of Florida's phosphate rock was exported along with phosphate fertilizer products. Major customers were Japan, Canada, and the Republic of Korea.

Land-pebble phosphate was produced at 21 mines by 12 companies in Hamilton, Hardee, Hillsborough, Manatee, and Polk Counties. Of the 12 companies with mining operations, 9 increased production in 1984, and 3 decreased production. Two companies increased export tonnage in 1984, one remained at about the same level, seven decreased exports, and two did not export. In 1984, agricultural uses accounted for nearly all of the production. Normal superphosphate, triple superphosphate, wet-process phosphoric acid, phosphate rock for direct application, and defluorinated phosphate rock were produced for agricultural purposes. All of the companies produced wet-process phosphoric acid, three produced triple superphosphate, three produced normal superphosphate, one produced direct-application material, and one produced defluorinated rock.

Because of strong demand, sulfur prices increased several times during 1984 with some companies raising prices as much as 20%. The Florida phosphate industry was the largest consumer of sulfur in the world and was seeking ways to reduce costs, including the use of prilled sulfur instead of liquid sulfur. Domestic phosphate producers, because of market conditions, may not be able to pass on increased costs, which could seriously impair their profitability.

Zen-Noh Phosphate Corp., a Japanese subsidiary that has a joint venture with Estech Inc. and an agreement with IMC, reported that it received nearly 1 million tons of rock in 1984. Zen-Noh also estimated that an additional 400,000 tons was imported by other Japanese companies.

Agrico operated the Fort Green, Payne Creek, and Saddle Creek Mines during the year. The Payne Creek Mine was reopened early in the year, and all mines operated at various levels of capacity during 1984. Agrico continued efforts to import prilled sulfur from Canada to replace liquid sulfur now being used to produce sulfuric acid. Agrico's application called for 600,000 tons of prilled sulfur per year, which would save $6.4 million in raw material costs. Although an emission permit was granted by DER, regulations had yet to be developed, and a decision to permit shipments through the Tampa terminal was not expected until 1985. Agrico concluded its second set of drill hole tests in St. Johns County to determine the feasibility of borehole mining of deep phosphate. If feasible and permits are obtained, the next phase would be full-scale production. Agrico indicated full-scale production would be achieved in about 10 years. Preliminary testing was done in cooperation with the U.S. Bureau of Mines.

AMAX Chemical Inc. reopened its Piney Point fertilizer plant and Big Four Mine in December 1983. At midyear, AMAX announced it would restart development of its proposed Pine Level Mine in DeSoto and Manatee Counties. As market prices decreased and sulfur prices increased, AMAX announced its facilities were for sale. The Big Four Mine was closed indefinitely in October, and by December the Piney Point plant also was closed indefinitely. Late in the year, AMAX wrote down $195 million in property, equipment, and inventory value of its Florida holdings and a potash mine in New Mexico. The reduction in value of its facilities to $108 million could make them easier to sell.

Beker Phosphate Corp. operated its Wingate Creek Mine in Manatee County using floating dredges to remove overburden and matrix. Beker's dredges had been considered "vessels" and exempt from property taxes, but the State Legislature passed a bill in 1984 requiring property taxes on dredges. Phosphate rock was trucked to Port Manatee for shipment to Beker's fertilizer plant in Louisiana. Controversy continued over truck transportation during 1984 as Beker had difficulty obtaining rights of way for a proposed rail line. Partial settlement of the issue was made by a Circuit Court judge who ruled that, unless the Cabinet rules otherwise, Beker has 3 years to complete the rail line. Beker announced plans to increase annual production from the Wingate Creek Mine from 1.3 million tons in 1984 to 1.9 million tons in 1985.

Brewster Phosphates, a partnership between American Cyanamid Co. and Kerr-McGee Corp., operated the Haynsworth and Lonesome Mines at various work schedules during the year. Most of the output was shipped through the Port of Tampa to a phosphoric acid plant in Louisiana. Late in the year, Kerr-McGee took a $4 million write-down of its interest in the two mines in Florida. Kerr-McGee also placed its interest in Brewster for sale.

CF Industries Inc. operated at less than capacity during 1984. CF announced plans to reopen its Bartow fertilizer facility in January 1985. The plant would operate at one-third capacity and produce about 240,000 tons annually of phosphoric acid. The Plant City plant would continue to operate at capacity. The reopening of the Bartow plant would replace fertilizer purchased under contract. In 1984, CF sold fertilizer to 16 cooperatives. Preliminary work was conducted on CF's proposed Hardee Complex II Mine in Hardee County.

Estech operated the Watson Mine and closed the Silver City Mine. The mines have a combined annual capacity of about 2 million tons with depletion expected in about 5 years. After nearly a decade of attempts to obtain permits to develop the Duette deposit, Estech offered to sell the 10,500-acre site to Manatee County for $35 million. Manatee voters approved a referendum to purchase the property through issuance of $25 million in bonds and the balance through State grants. Negotiations started late in the year with Estech officials. Environmental concerns had delayed development since 1975; these concerns centered on endangerment to water quality in the Manatee River reservoir, the main water source for 250,000 residents. Early in the year, Estech offered its operations for sale, and sold 1,300 acres of phosphate lands to IMC. The land, adjacent to the Noralyn Mine, reportedly contained 7 to 8 million tons of recoverable phosphate rock.

Farmland Industries Inc. purchased phosphate rock for its Green Bay chemical plant. Plans for development of its Hickory Creek Mine in Hardee County were deferred.

Gardinier Inc. produced phosphate rock at its Fort Meade Mine in Polk County. In November, Gardinier closed the mine for over 2 months for inventory control. The company's chemical plant south of Tampa continued to operate at normal levels. Gardinier announced that the mine and plant were for sale.

W. R. Grace & Co. operated its Bonny Lake and Hookers Prairie Mines in Polk County in 1984. Early in the year the Bonny Lake Mine was depleted and shut down permanently after 37 years of operation. During 1984, W. R. Grace operated from one to all three units at its phosphoric acid plant, depending on the status of inventories. The company completed the purchase of reserves from Agrico adjacent to its Hookers Prairie Mine. The addition of 16 million tons of reserve, along with improvements to its chemical complex at Bartow, was completed at a cost of about $25 million. W. R. Grace planned to build a 36-megawatt cogenerator unit at Bartow for $25 million, which was scheduled for completion in 1986; the company had previously built a similar unit at Fort Meade. The startup of W. R. Grace's Four Corners Mine, a joint venture with IMC, was scheduled for January 1985. The 5-million-ton-per-year-capacity mine, delayed for 2 years because of poor market conditions, was developed for about $300 million. The Four Corners Mine, with a life expectancy of over 20 years, was expected to operate at less than capacity in 1985. W. R. Grace would operate the mine, with 50% of the output going to IMC.

Hopewell Land Co., a subsidiary of Noranda Inc., announced plans to begin operation at its new 550,000-ton-per-year mine in Hillsborough County in January 1985. Hopewell expects to mine about 100 acres per year over a 24-year period. The mine's wet-rock product would be shipped to Mobil Chemical Corp.'s drying plant at Nichols and then exported through the Port of Tampa.

IMC, the world's largest private producer of phosphate rock and phosphate chemical products, operated the Clear Springs, Noralyn, and Kingsford Mines. Although the mines did not operate at design capacity, IMC's production levels were not affected as much as those of other Florida companies. IMC started up its third phosphoric acid train at the New Wales plant at midyear; although the $170 million plant was completed over 2 years earlier, the unit had never been in operation. The two other trains had been operating at capacity; but with the startup of the third train, all would operate at less than capacity. The new Four Corners Mine, a venture with W. R. Grace, was expected to provide rock for the New Wales phosphoric acid plant when the mine opens in January 1985. The New Wales plant, with a capacity of 1.5 million tons of phosphoric acid annually, was scheduled to produce about 1.2 million tons in 1985.

Mobil operated the Nichols and Fort Meade Mines in Polk County. At midyear, Mobil reopened the Nichols Mine, closed since early 1983, at reduced work schedules. No increase in production was anticipated as Mobil also reduced output from the Fort Meade Mine. Both mines were expected to be phased out if Mobil's proposed 5-million-ton-per-year mine is developed at South Fort Meade; permitting was in progress. At midyear, the Governor and Cabinet rejected the reclamation plan for the new mine and directed DNR and local officials to assist Mobil in developing an acceptable plan. Mobil and Monsanto agreed to conduct a joint test of Monsanto's clay settling technology—electroendosmosis—at the Fort Meade Mine. Monsanto developed the method in Tennessee; prior experiments along these lines had accomplished their goals but used too much electricity to be economical.

Occidental produced phosphate rock from its Suwanee River and Swift Creek Mines in 1984. The Swift Creek Mine, closed late in 1983, reopened in August. Occidental ships superphosphoric acid to the U.S.S.R. in return for ammonia and urea. Occidental also exports phosphate rock; all exports go through the Jacksonville Bulk Terminal.

Royster Co. signed an agreement to sell its facilities to Superfos N/A, a Danish fertilizer firm, for about $100 million. Royster has a fertilizer plant near Mulberry, an ammonia facility in Tampa, and several out-of-State operations. Royster recently embarked on a $12 million program at its Mulberry facility to build a sulfuric acid plant, a cogeneration unit, and a cooling tower. Superfos reportedly entered negotiations with AMAX concerning its fertilizer assets that were for sale.

U.S.S. Agri-Chemicals Inc. restarted its Rockland Mine in April because a contract to purchase phosphate rock from IMC expired. The mine had been closed for about 2 years. The rock was shipped to the company's Fort Meade plant, which was capable of producing 121,000 tons of product per year. The Fort Meade plant, closed for 2 months at midyear, closed again in November with scheduled reopening early in 1985. The Bartow phosphoric acid plant was closed permanently in January but had been inactive since 1981.

**Sand and Gravel.**—Florida produced both construction and industrial sand and gravel in 1984. Production was from 37 companies at 56 operations in 18 counties. Total output increased and reached its highest level since 1979.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel was the fourth leading commodity in value among the nonfuel minerals produced in Florida. The increase in 1984 was basically due to the surge in all construction sectors during the year. During 1984, 30 companies produced from 44 operations in 18 counties; leading counties were Lake, St. Lucie, and Sarasota. Transportation was mainly by truck. Principal uses included concrete aggregate and fill. Four companies produced over 1 million short tons; the top 9 companies, with 22 operations, mined 90% of the total construction sand and gravel mined in the State.

**Table 4.—Florida: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 12,159 | $30,389 | $2.50 |
| Plaster and gunite sands | 277 | 1,056 | 3.82 |
| Concrete products | W | W | 2.03 |
| Asphaltic concrete | 904 | 1,844 | 2.04 |
| Road base and coverings | W | W | 2.00 |
| Fill | 2,348 | 2,912 | 1.24 |
| Other[1] | 5,343 | 12,293 | 2.30 |
| Total or average | [2]21,032 | 48,494 | 2.31 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes other unspecified uses and uses indicated by symbol W.

[2] Data do not add to total shown because of independent rounding.

*Industrial.*—Seven companies produced industrial sand and gravel, one as a byproduct of kaolin operations. Production increased significantly as unit values decreased. Industrial sand was used in glass manufacture and for foundry sands with markets for both uses in Alabama, Florida, Georgia, and Tennessee.

**Staurolite.**—Florida was the only State with a recorded production of staurolite, an iron-aluminum silicate. Staurolite was recovered as a coproduct of heavy-mineral processing in Clay County by Associated Minerals (USA) Ltd. Inc. and by E. I. du Pont de Nemours & Co. Inc. Staurolite was recovered by electrostatic and magnetic separation from heavy mineral concentrates. Production and value increased over that of 1983, with an increase in unit value. Staurolite was used mainly in foundry applications, for sandblasting, and in cement manufacture where it was used as a fluxing agent.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone ranked second in mineral value in Florida with output estimated to have increased over that of 1983. Increased construction activity was basically the reason for increased production. Florida ranked second in the Nation in crushed stone production in 1983, and estimates indicate the State maintained that ranking in 1984. Florida produced limestone, dolomite, marl, and oystershell. Crushed stone was used mainly for dense-graded road base, concrete and bituminous aggregate, and cement manufacture. Production was estimated to approach that of the record output years of 1979-81. Southern Materials Corp., Lowell, produced a fine calcium carbonate for use in filler and extender applications. The operation shipped product to eight States. Florida Rock Industries Inc., the second largest producer of crushed stone in Florida, purchased two quarries in south Florida from Sterling Crushed Stone Co.

**Sulfur (Recovered).**—Florida ranked 10th nationally in the recovery of byproduct elemental sulfur. Output from Exxon Corp.'s natural gas desulfurization plant in Santa Rosa County decreased for the sixth straight year, as oil and gas production decreased.

**Vermiculite (Exfoliated).**—Exfoliated vermiculite was produced by two companies at four plants in Broward, Duval, and Hillsborough Counties from crude ore shipped into the State. Florida ranked third nationally in output of exfoliated vermiculite. Production increased 3.8% while value decreased 8.2% from that of 1983. Principal uses were for concrete aggregate, horticulture, and insulation.

## METALS

**Ferroalloys.**—Two companies produced ferroalloys in Florida with output increasing. Electro-Phos Corp., Pierce, and Stauffer Chemical Co., Tarpon Springs, produced ferrophosphorous in 1984.

**Iron and Steel.**—Florida Steel Corp., one of the Nations's top 15 steelmakers, operated minimills at Jacksonville and Tampa during the year. The company has five plants nationwide and was the Nation's fourth largest minimill operator with a total rated capacity of 1.6 million short tons per year. The company announced an $11.5 million expansion at its Jacksonville plant to include a rod block along with related facilities. The facility, scheduled for completion late in 1985, will add coiled rebar to the company's product line. The company's Indiantown facility remained closed with tentative plans for future reopening. Florida Steel, after 2 years of losses, reported a profit for the fiscal year ending September 30, 1984.

According to the Directory of Florida Industries, 10 gray iron foundries and 9 steel foundries operated in the State. Seventeen of these foundries were relatively small.

**Mineral Sands.**—Du Pont and Associated Minerals produced concentrate from their heavy minerals operations in Clay County. Both rutile and ilmenite shipments increased over those of 1983; unit prices increased for rutile and decreased for ilmenite. Florida was the only producer of rutile and one of two States with ilmenite shipments. Associated Minerals' newly opened ore body was expected to add 12 to 13 years to the life of the operations. The company's cutter header dredge was expected to be changed to bucket wheel early in 1985. Exploration by both companies continued, and the construction of a synthetic rutile plant by Associated Minerals was still a possibility. Output of mineral sands was shipped to users throughout the Southeast.

**Rare-Earth Minerals.**—Florida was the only producer of rare earths from mineral sands mining. Associated Minerals recovered monazite concentrate as a byproduct of its operation in Clay County. Output increased significantly along with unit prices.

**Zircon.**—Production of zircon concentrates from Du Pont and Associated Minerals operations in Clay County increased significantly; unit prices decreased over 10%. Florida was the only U.S. producer of zircon, which was recovered as a byproduct of mineral sands operations. Principal markets were in the foundry, refractory, and ceramic industries.

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] State geologist, Florida Bureau of Geology, Tallahassee, FL.

[3] Federal Reserve Bank of Atlanta. Economic Review. Feb. 1985, pp. 12-22.

**Table 5.—Principal producers**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| General Portland Inc | 12700 Park Central Pl.<br>Suite 2100<br>Dallas, TX 75251 | Plants | Dade and Hillsborough. |
| Lonestar Florida Pennsuco Inc | Box 2035 PVS<br>Hialeah, FL 33012 | Plant | Dade. |
| Moore McCormack Resources Inc. | Box 23965<br>Tampa, FL 33622 | do | Hernando. |
| National Portland Cement Co | Route 1<br>Port Manatee, FL 33561 | do | Manatee. |
| Rinker Portland Cement Corp | Box 650679<br>Miami, FL 33165 | do | Dade. |
| Clays: | | | |
| Engelhard Minerals & Chemical Corp. | Menlo Park<br>Edison, NJ 08817 | Open pit mines and plant. | Brevard. |
| Florida Mining & Materials Corp. | Box 6<br>Brooksville, FL 33512 | do | Hernando. |
| Mid-Florida Mining Co | Box 68-F<br>Lowell, FL 32663 | do | Marion. |
| Pennsylvania Glass Sand Corp | Berkeley Springs, WV 25411 | do | Gadsden. |
| Gypsum (calcined): | | | |
| Jim Walter Corp | Box 135<br>Jacksonville, FL 32226 | Plant | Duval. |
| National Gypsum Co | 4100 Inter First Two<br>Dallas, TX 75270 | do | Hillsborough. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Duval. |
| Lime: | | | |
| Basic Magnesia Inc | Box 160<br>Port St. Joe, FL 32456 | do | Gulf. |
| Chemical Lime Inc | Box 317<br>Leesburg, FL 32748 | do | Hernando. |
| Dixie Lime & Stone Co.[1] | Drawer 217<br>Sumterville, FL 33585 | do | Sumter. |
| Magnesia: | | | |
| Basic Magnesia Inc | Box 160<br>Port St. Joe, FL 32456 | do | Gulf. |
| Peat: | | | |
| Atlas Peat & Soil Inc | Box 867<br>Boynton Beach, FL 33435 | Bog | Palm Beach. |
| Superior Peat & Soil Co | Box 1688<br>Sebring, FL 33870 | Bog | Highlands. |
| Perlite (expanded): | | | |
| Airlite Processing Corp. of Florida. | Route 2, Box 740<br>Vero Beach, FL 32960 | Plant | Indian River. |
| Armstrong Cork Co | Box 1991<br>Pensacola, FL 35289 | do | Escambia. |
| Chemrock Corp | End of Osage St.<br>Nashville, TN 37208 | do | Duval. |
| W. R. Grace & Co.[2] | 62 Whittemore Ave.<br>Cambridge, MA 02140 | do | Broward. |
| Phosphate rock: | | | |
| Agrico Chemical Co | Box 1110<br>Mulberry, FL 33860 | Open pit mines and plants. | Polk. |
| AMAX Chemical Inc | 402 South Kentucky Ave.<br>Lakeland, FL 33801 | Open pit mine and plant. | Hillsborough. |
| Beker Phosphate Corp | Box 9034<br>Bradenton, FL 33506 | do | Manatee. |
| Brewster Phosphates | Bradley, FL 33835 | Open pit mines and plant. | Hillsborough and Polk. |

See footnotes at end of table.

Table 5.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| **Phosphate rock —Continued** | | | |
| CF Industries Inc | Box 790<br>Plant City, FL 33566 | Open pit mine and plant. | Hardee. |
| Estech Inc | Box 208<br>Bartow, FL 33830 | Open pit mines | Polk. |
| Gardinier Inc | Box 3269<br>Tampa, FL 33601 | Open pit mine and plant. | Do. |
| W. R. Grace & Co | Box 471<br>Bartow, FL 33830 | Open pit mines and plant. | Do. |
| International Minerals & Chemical Corp. | Box 867<br>Bartow, FL 33830 | do | Do. |
| Mobil Chemical Corp.[3] | Box 311<br>Nichols, FL 33863 | do | Do. |
| Occidental Chemical Co | White Springs, FL 32096 | do | Hamilton. |
| U.S.S. Agri-Chemicals Inc | Box 867<br>Fort Meade, FL 33841 | Open pit mine and plant. | Polk. |
| Sand and gravel: | | | |
| Florida Rock Industries Inc., Shands & Baker. | Box 4667<br>Jacksonville, FL 32201 | Pits | Clay, Glades, Lake, Marion, Polk, Putnam. |
| General Development Corp | 1111 South Bayshore Dr.<br>Miami, FL 33131 | do | St. Lucie and Sarasota. |
| E. R. Jahna Industries Inc., Ortona Sand Co. Div. | First & East Tillman<br>Lake Wales, FL 33853 | do | Hendry, Lake, Polk. |
| Silver Sand Co. of Clermont Inc. | Route 1, Box US1<br>Clermont, FL 32711 | Pit | Lake. |
| Staurolite: | | | |
| Associated Minerals (USA) Ltd. Inc. | Green Cove Springs, FL 32043 | Mine and plant | Clay. |
| E. I. du Pont de Nemours & Co. Inc. | DuPont Bldg. D-10084<br>Wilmington, DE 19898 | Mines and plants | Do. |
| Stone: | | | |
| Florida Crushed Stone Co | Box 317<br>Leesburg, FL 32748 | Quarries | Hernando and Sumter. |
| Florida Rock Industries Inc | Box 4467<br>Jacksonville, FL 32201 | do | Alachua, Collier, Hernando, Lee, Levy, St. Lucie, Taylor. |
| Lone Star Florida Inc | Box 6097<br>Fort Lauderdale, FL 33310 | Quarry | Dade. |
| Rinker Southeastern Materials Inc. | Box 5230<br>Hialeah, FL 33014 | Quarries | Do. |
| Vulcan Materials Co | Box 660097<br>Miami Springs, FL 33166 | do | Broward and Dade. |
| Titanium concentrates: | | | |
| Associated Minerals (USA) Ltd. Inc. | Green Cove Springs, FL 32043 | Mine and plant | Clay. |
| E. I. du Pont de Nemours & Co. Inc. | DuPont Bldg. D-10084<br>Wilmington, DE 19898 | Mines and plants | Do. |

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[1] Also stone.

[2] Also exfoliated vermiculite.

[3] Also elemental phosphorus.

# The Mineral Industry of Georgia

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources, for collecting information on all nonfuel minerals.**

### By Doss H. White, Jr.,[1] and Bruce J. O'Connor[2]

The value of Georgia's nonfuel mineral production in 1984 reached a record high of $940 million, exceeding the former record established in 1983 by $90.9 million. Georgia ranked seventh in the Nation in the value of nonfuel mineral production, and third in the Eastern United States.

The record-high mineral sales reported during 1984 was primarily due to a strong demand by the construction industry for mineral raw materials and by the paper, plastics, rubber, and whiteware industries for kaolin.

**Table 1.—Nonfuel mineral production in Georgia[1]**

| Mineral | | 1983 | | 1984 | |
|---|---|---|---|---|---|
| | | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays | thousand short tons | 7,859 | $560,005 | 8,679 | $600,029 |
| Gem stones | | NA | 20 | NA | 20 |
| Sand and gravel: | | | | | |
| Construction | thousand short tons | [e]3,800 | [e]9,400 | 5,347 | 13,623 |
| Industrial | do | 539 | 7,298 | 478 | 6,795 |
| Stone: | | | | | |
| Crushed | do | 41,100 | [r]186,193 | [e]45,900 | [e]220,000 |
| Dimension | do | [r]183 | [r]21,019 | [e]202 | [e]20,007 |
| Talc | do | 14 | 101 | 15 | 104 |
| Combined value of barite, bauxite, cement, feldspar, iron oxide pigments (crude), kyanite, mica (scrap), and peat | | XX | 65,536 | XX | 79,914 |
| Total | | XX | [r]849,572 | XX | 940,492 |

[e]Estimated. [r]Revised. NA Not available. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Georgia, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Baldwin | W | (2) | |
| Barrow | (2) | $678 | Stone (crushed). |
| Bartow | W | W | Barite, iron oxide pigments, clays. |
| Bibb | W | W | Clays. |
| Brantley | W | -- | |
| Carroll | (2) | W | Stone (crushed). |
| Chatham | W | (2) | |
| Cherokee | -- | W | Stone (crushed). |
| Clarke | (2) | W | Do. |
| Clayton | (2) | W | Do. |
| Cobb | W | W | Do. |
| Columbia | W | 2,787 | Stone (crushed), clays. |
| Columbus (city) | $228 | -- | |
| Cook | W | W | Peat. |
| Coweta | (2) | W | Stone (crushed). |
| Crawford | W | W | Sand (industrial). |
| Decatur | W | W | Clays. |
| De Kalb | (2) | 18,610 | Stone (crushed), stone (dimension). |
| Dougherty | 192 | (2) | |
| Douglas | W | W | Stone (crushed), clays. |
| Effingham | W | (2) | |
| Elbert | W | 3,069 | Stone (dimension), stone (crushed). |
| Evans | 160 | (2) | |
| Fannin | (2) | W | Stone (dimension). |
| Fayette | (2) | W | Stone (crushed). |
| Floyd | W | W | Stone (crushed), clays. |
| Forsyth | (2) | W | Stone (crushed). |
| Fulton | 22,678 | 38,608 | Cement, stone (crushed), clays. |
| Gilmer | (2) | W | Stone (crushed), stone (dimension). |
| Glynn | 51 | (2) | |
| Gordon | (2) | W | Stone (crushed). |
| Greene | W | W | Sand and gravel (industrial). |
| Gwinnett | (2) | W | Stone (crushed). |
| Habersham | (2) | W | Do. |
| Hall | (2) | 6,468 | Do. |
| Hart | W | W | Mica. |
| Henry | (2) | W | Stone (crushed). |
| Houston | W | W | Cement, stone (crushed), clays. |
| Jasper | W | W | Feldspar. |
| Jefferson | W | 18,103 | Clays. |
| Jones | (2) | W | Stone (crushed). |
| Lee | W | W | Do. |
| Lincoln | W | W | Kyanite. |
| Long | W | (2) | |
| Lowndes | W | -- | |
| Lumpkin | (2) | W | Stone (crushed). |
| Madison | (2) | W | Stone (dimension). |
| Marion | W | W | Sand and gravel (industrial). |
| Miller | -- | 283 | Stone (crushed). |
| Monroe | (2) | W | Do. |
| Montgomery | W | (2) | |
| Murray | 141 | W | Talc. |
| Muscogee | -- | W | Stone (crushed). |
| Newton | (2) | W | Do. |
| Oglethorpe | (2) | 4,081 | Stone (dimension). |
| Paulding | (2) | -- | |
| Pickens | (2) | W | Stone (dimension), stone (crushed). |
| Pike | W | (2) | |
| Polk | (2) | W | Stone (crushed). |
| Rabun | (2) | W | Do. |
| Richmond | 3,153 | W | Clays, stone (crushed). |
| Screven | W | W | Peat. |
| Seminole | W | (2) | |
| Spalding | (2) | W | Stone (crushed). |
| Stephens | (2) | W | Do. |
| Sumter | W | W | Clays, bauxite. |
| Talbot | W | (2) | |
| Taylor | W | (2) | |
| Thomas | W | W | Clays, sand (industrial). |
| Towns | (2) | -- | |
| Troup | (2) | W | Stone (crushed). |
| Twiggs | 94,203 | 109,528 | Clays. |
| Union | (2) | (2) | |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Georgia, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Walker | (3) | W | Stone (crushed). |
| Ware | (3) | (2) | |
| Warren | W | $43,781 | Clays, stone (crushed). |
| Washington | $172,449 | 178,575 | Clays. |
| Wheeler | W | (2) | |
| Whitfield | (3) | W | Stone (crushed). |
| Wilkes | (3) | W | Stone (dimension). |
| Wilkinson | 75,902 | 99,606 | Clays. |
| Undistributed[4] | 176,809 | 321,044 | |
| Sand and gravel (construction) | XX | 9,400 | |
| Stone: | | | |
| Crushed | [e]153,500 | XX | |
| Dimension | [r] [e]19,375 | XX | |
| Total[5] | [r]718,838 | 849,572 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No production of nonfuel mineral commodities was reported for counties not listed.

[2]Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3]Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[4]Includes some clays and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Georgia business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 5,651 | 5,732 | 5,837 |
| Total civilian labor force | do | 2,664 | 2,685 | 2,760 |
| Unemployment | do | 208 | 201 | 166 |
| Employment (nonagricultural): | | | | |
| Mining total | do | 7.4 | 7.3 | 7.9 |
| Manufacturing total | do | 500.3 | 511.1 | 545.4 |
| Primary metal industries | do | 16.1 | 15.0 | 16.2 |
| Stone, clay, and glass products | do | 16.3 | 17.7 | 19.0 |
| Chemicals and allied products | do | 17.4 | 17.9 | 18.9 |
| Construction | do | 103.0 | 108.8 | 132.4 |
| Transportation and public utilities | do | 146.4 | 147.7 | 155.1 |
| Wholesale and retail trade | do | 520.0 | 547.6 | 608.2 |
| Finance, insurance, real estate | do | 117.2 | 121.8 | 128.9 |
| Services | do | 373.2 | 397.6 | 440.0 |
| Government and government enterprises | do | 434.0 | 437.6 | 439.9 |
| Total[1] | do | 2,201.5 | 2,279.3 | 2,457.7 |
| Personal income: | | | | |
| Total | millions | $54,363 | $59,698 | $67,416 |
| Per capita | | $9,626 | $10,415 | $11,551 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.6 | 41.4 | 41.0 |
| Total average hourly earnings, production workers | | $6.75 | $7.13 | $7.58 |
| Earnings by industry: | | | | |
| Farm income | millions | $822 | $725 | $1,131 |
| Nonfarm | do | $40,269 | $44,734 | $50,843 |
| Mining total | do | $160 | $172 | $201 |
| Manufacturing total | do | $9,163 | $10,131 | $11,482 |
| Primary metal industries | do | $382 | $396 | $466 |
| Stone, clay, and glass products | do | $334 | $387 | $437 |
| Chemicals and allied products | do | $407 | $441 | $513 |
| Construction | do | $2,139 | $2,420 | $3,049 |
| Transportation and public utilities | do | $4,245 | $4,638 | $5,062 |
| Wholesale and retail trade | do | $7,777 | $8,625 | $10,060 |
| Finance, insurance, real estate | do | $2,273 | $2,682 | $3,102 |
| Services | do | $6,438 | $7,399 | $8,562 |
| Government and government enterprises | do | $7,928 | $8,504 | $9,137 |

See footnotes at end of table.

**Table 3.—Indicators of Georgia business activity —Continued**

| | 1982^r | 1983 | 1984^p |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 39,437 | 66,417 | 70,438 |
| Value of nonresidential construction ____ millions | $1,044.7 | $1,469.9 | $1,875.5 |
| Value of State road contract awards ____ do | $425.0 | $292.6 | $452.0 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,920 | 2,445 | 2,984 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value ____ millions | $718.8 | $849.6 | $940.5 |
| Value per capita | $127 | $148 | $161 |

^p Preliminary. ^r Revised.

[1] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

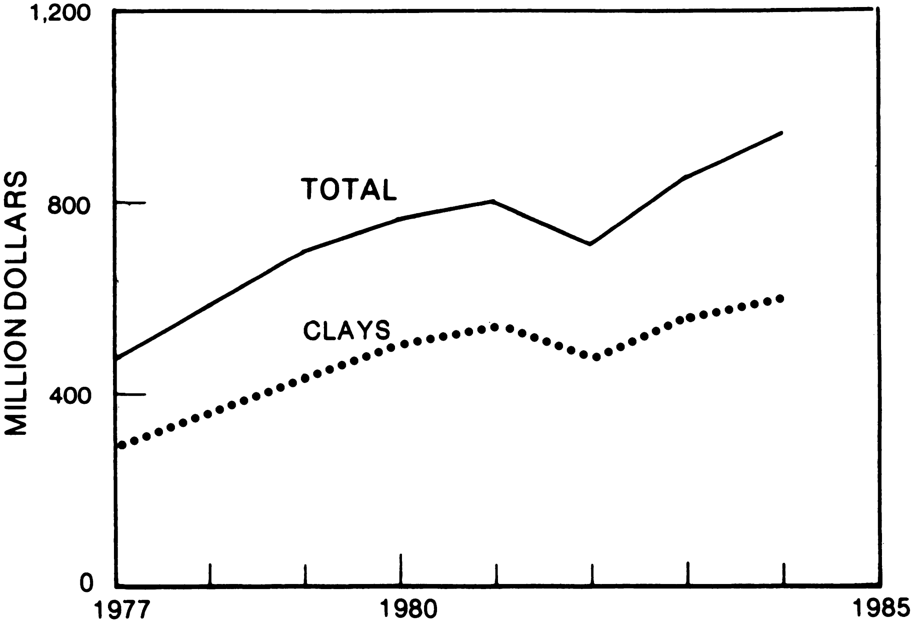

Figure 1.—Value of clays and total value of nonfuel mineral production in Georgia.

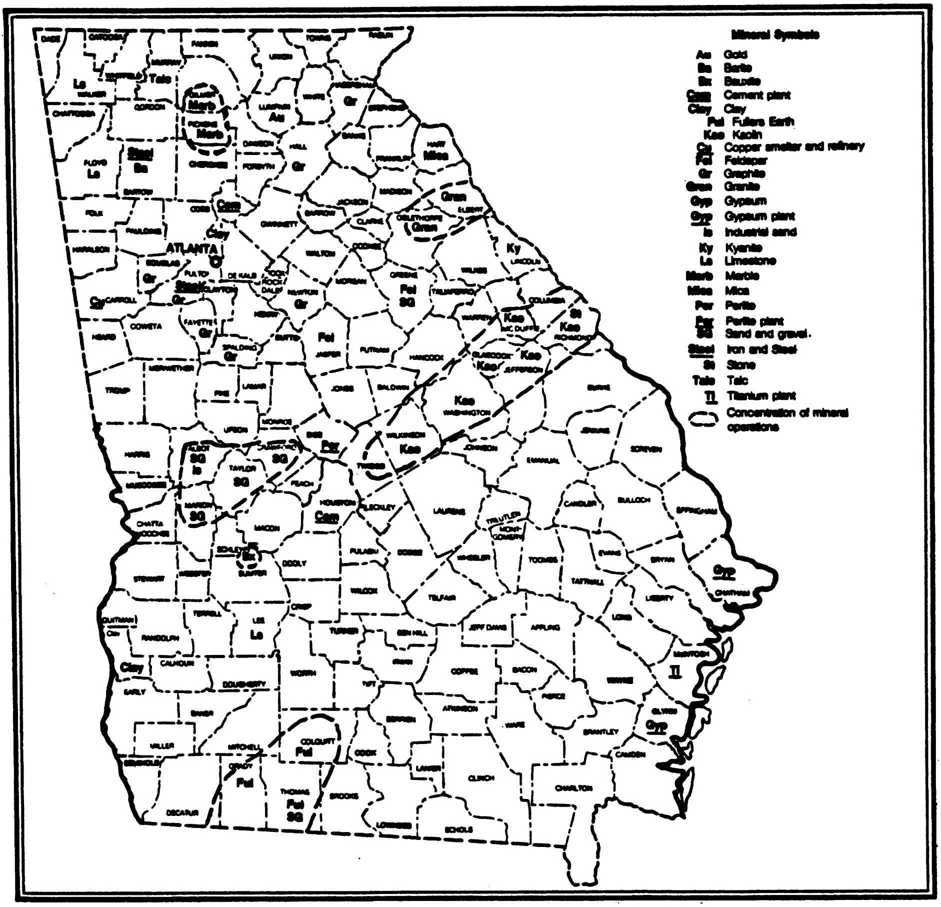

Figure 2.—Principal mineral producing localities in Georgia.

**Trends and Developments.**—Unlike many of the Sun Belt States where the primary market for mineral production is the construction industry, Georgia's mineral producers also supply the paper industry and a large percentage of the extender and filler needs of U.S. manufacturers. The State is also a leading producer of dimension stone for structural and monumental applications. This multifaceted production helps to insulate the mineral industry from the economic slumps experienced in States where mineral sales are restricted to one or two industries.

The State's construction industry prosperod in 1984, and the sector of Georgia's mineral industry that supplied construction raw materials (cement, clays, sand and gravel, and stone) reported record high sales. Construction activity in the State is noted in table 3.

To help satisfy existing or projected market demands, several plant expansions were in various stages of planning or under construction. Many of these were clay related and are noted in the "Clays" section.

In other developments, Riverside Products Corp. of Cartersville began operation of a 20,000-short-ton-per-year sodium bicarbonate plant. A sister company, Chemical Products Corp., a barium chloride and carbonate producer, petitioned the U.S. International Trade Commission (ITC) that China was dumping barium compounds on the U.S. market. The Commission ruled that the company had been injured and established a 14.5% tariff on barium chloride imports.

Mineral shipments are a significant part of the bulk cargo moved through the State's ports and river terminals. Mineral commodities imported through Georgia's ports included copper, gypsum, oil, perlite, potash, salt, steel, and sulfur. Exports included granite and kaolin.

Georgia has several mining and trade associations supporting the mineral industry. Among these are the Georgia Mining Association (GMA) and the Georgia Crushed Stone Association (GCSA).

GMA was founded in 1972 to promote the interests of the member companies and to help inform the citizens of the State of the importance of the mineral industry to the State's mineral and economic needs. GMA publishes several "Miningrams" each year reporting legislative and other news affecting the industry, presents an annual scholarship to a high school student, and hosts an annual meeting and several industry-related workshops.

GCSA, representing the major crushed stone producers in the State, informed both public and legislative sectors of the importance of the stone industry to the State's economy and growth. In 1984, GCSA's slide presentation "The GCSA—Today" was completed and viewed by approximately 20,000 citizens at several meetings including engineering, municipal, and public works conventions. GCSA also hosted a plant Management Workshop and other meetings.

**Legislation and Government Programs.**—The Georgia General Assembly is a biennial, 2-year legislature, and the 1984 session was the second half of the biennium. In January, a bill was introduced to raise the performance bond posted by mining companies from $1,000 to equal the cost of reclamation work. Other provisions of the bill would (1) grant the State the right to seek civil penalties from bonded mining companies to recover the full cost of land restoration, (2) discontinue the program allowing a mining firm to redeem an equal amount of land elsewhere in the State while leaving the current mining site unreclaimed, and (3) discontinue bonding exemptions extended to some mining companies with a good reclamation record. The bill was carried over to the 1985 session.[3]

The 1984 General Assembly amended existing flow control legislation, which granted the State a monopoly over recyclable scrap recovery. The revised law specifies that a government monopoly over collecting, processing, and disposing of resources in solid waste does not include solid waste or resources "as may be separated for recycling at any time prior to pickup by or delivery to" the authorized resource recovery facility.

In June, a six-member legislative panel was appointed to investigate surface mining in Georgia to determine the effectiveness of the State's 1968 Mine Land Reclamation Act. The panel, sponsored by the House Surface Mining Subcommittee, conducted a series of hearings and reported its findings and recommendations to the Natural Resources Committee.[4]

In 1983, the Georgia Department of Transportation announced a change in calculating excess truck weights that exempted certain commodities if cargo weights were distributed to meet axle weight requirements. GMA and three kaolin companies filed suit contending that the exemption violated the equal protection guarantees of the U.S. Constitution. The exemptions were overturned by a lower court. However, in February 1984, the Georgia Supreme Court reversed the lower court in a 5 to 2 decision.[5]

Several programs by Federal and State government have a direct bearing on past or current mineral preduction. The Bureau of Mines, U.S. Department of the Interior, is the Nation's principal scientific-engineering agency involved in minerals data research and in the research and development of improved, safe, and environmentally acceptable methods of mining and processing the mineral requirements of the United States. In 1984, all mineral producers in the State were canvassed to develop baseline data on mineral preduction and value. This was part of a nationwide program to track domestic mineral production and identify trends in supply and demand. During the year, the Bureau's staff at the Tuscaloosa Research Center in Tuscaloosa, AL, worked with a number of Georgia's mineral producers on problems and solutions on mining or beneficiation of Georgia's minerals. The Bureau also published the results of two studies on the extraction of alumina or aluminum from kaolin mined in Georgia: (1) Report of Investigations (RI) 8866, "A Basic Chloride Method for Extracting Aluminum From Clay," and (2) RI 8877, "Alumina Miniplant Operations—Influence of Reactor Design on the Attrition of Calcined Kaolin During HCL Leaching."

Geologists with the Bureau of Mines Intermountain Field Operations Center, Denver, CO, completed fieldwork on the Anna Ruby, Board Camp, Brasstown, Buzzard Knob, Rabun Bald, Raven, Wolf Pen, and Worley Ridge Roadless Areas Review and Evaluation (RARE II) areas. Report preparations on these areas are scheduled for completion in 1985. The report on the Blood Mountain area was published in 1984.

The Bureau also contracted with a number of Georgia research agencies to develop methodology and/or equipment for use in solving problems relating to the Nation's mining industry. Among the contract subjects were (1) development of calcia stabilized zirconia as a castable, (2) a study of surface coal mine slope stability problems in the Eastern Coal Province, (3) further study of detoxication of arsenic, (4) water purification with cyanobacteria, and (5) Florida phosphate mine reclamation.

The Office of Surface Mining, U.S. Department of the Interior, spent $670,000 in the northwestern Georgia coalfield in 1984. The agency contracted to repair an unstable sediment dam on a small river 1/4-mile upstream from Girl Scout Camp Juliette Low in Chattooga County. The agency also contracted to permanently close the shafts of two long-abandoned coal mines that were potential hazards to hikers and hunters.

The Corps of Engineers reissued a Regional Permit "authorizing minor discharges of fill material in waters of the United States incidental to certain specific activities associated with open pit mining of clays in the State of Georgia." The reissuance follows a lengthy corps review of the Regional Permit established several years ago to reduce paperwork and notification requirements for mining activities taking place in wetland areas.

The Regional Permit covers activities that would cause only minimal environmental disturbance. GMA requested that the corps extend the Regional Permit to all types of mining in Georgia. The corps had not responded to the request at yearend.

The Georgia Geologic Survey, an agency of the Department of Natural Resources (DNR), is the principal State body for the investigation of Georgia's geologic, hydrologic, and mineral resources. Survey personnel provide technical expertise to other groups in DNR and other State agencies promoting industrial development. The Survey is charged with the regulation of petroleum and natural gas exploration and Classes IV and V injection wells and administers the State's ground water management plan. From July 1, 1983, to June 30, 1984 (the State's fiscal year), the Survey published 12 reports and responded to approximately 10,000 information requests on the geology, hydrology, and mineral resources of the State.

The Survey's geology program emphasizes economic geology and the "Accelerated Minerals Program." This program includes investigations into (1) construction sand and gravel potential of the Coastal Plain, (2) the massive sulfide deposits of the State, (3) the gold resources of the State, (4) ultramafic rock bodies, and (5) ceramic clays and shales of the Valley and Ridge Province. Additionally, the Survey provides technical assistance and information to mining companies including the publication of a mining and geoscience facilities directory. Other activities include a major revision of the Cenozoic stratigraphy of the Coastal Plain and participation in the U.S. Department of Energy's Crystalline Rock Repository Study for high-level radioactive waste. With a grant from the Minerals Management Service, the Survey is evaluating offshore phosphate-bearing strata.

During 1984, the Survey employed 27 geologists and 10 support personnel.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

The strong economy, prevalent throughout the year, led to increased demand and sales of 11 of the 12 minerals produced in the State. In 1984, Georgia's mineral industry operated 402 surface mines, 4 underground mines, and 46 dimension stone quarries.

**Barite.**—Two companies, New Riverside Ochre Co. and Paga Mining Co., operated surface mines and flotation plants in the Cartersville District in northwest Georgia. New Riverside Ochre also recoverod iron oxide pigments and Paga dry-ground marble shipped from Alabama to produce four grades for filler and extender applications.

Paga produced three filler grades of barite for the paint, paper, plastics, and rubber industries.

New Riverside Ochre barite concentrates were used by an associate company in Cartersville, Chemical Products, for the production of barium chemicals, which, because of high density and brightness, inertness, and radiation absorption characteristics, have application in a variety of industries.

Chemical Products is the only remaining barium chemical producer in the United States. In 1983, the company filed an antidumping petition with the ITC concerning imports of Chinese barium chemicals. In 1984, the ITC ruled that the complaint on barium chloride was justified and awarded a 14.5% tariff on barium chloride imports.

**Cement.**—Blue Circle Inc. and Medusa Cement Co. comprise the State's cement manufacturing industry. Blue Circle operated a plant in Atlanta and Medusa's plant was at Clinchfield in Houston County.

The Atlanta plant consisted of four kilns, two wet-process units with an annual capacity rating of 193,000 short tons, and two dry-process units rated at 546,000 tons per year. The Clinchfield plant operated two dry-process kilns with a 300,000-ton-per-year capacity.

For the Atlanta operation, clay was mined from company-owned property in Douglas County, and limestone was shipped by rail from the Rome area in northwest Georgia; sand and iron scale were obtained from Alabama sources.

Raw materials—clay, sand, and stone—for the Medusa plant were obtained from Houston County, and iron scale was purchased from an in-State source.

Both operations produced portland and masonry cement. Output of portland was 7% higher, and output of masonry products was 18% above the 1983 levels.

**Clays.**—Georgia continued as the Nation's leading clay producing State. Kaolin was the leading clay produced in terms of production and sales, followed by fuller's earth and common clay and shale.

**Table 4.—Georgia: Clays sold or used by producers**

(Thousand short tons and thousand dollars)

| Year | Kaolin |  | Fuller's earth |  | Common clay |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value | Quantity | Value | Quantity | Value |
| 1980 | 6,811 | $463,700 | 649 | $32,667 | 1,823 | $4,187 |
| 1981 | 6,236 | 519,497 | 584 | 30,173 | 1,209 | 4,156 |
| 1982 | 5,268 | 445,389 | 534 | 27,558 | 970 | 2,821 |
| 1983 | 5,886 | 523,407 | 692 | 32,826 | 1,281 | 3,773 |
| 1984 | 6,508 | 562,697 | 569 | 32,415 | 1,601 | 4,918 |

*Kaolin.*—In 1984, the Georgia kaolin industry consisted of 19 companies operating 83 mines in a 9-county area along the Piedmont-Coastal Plain "fall line" in the east-central part of the State.

The effects of the worldwide recession during the early 1980's on the State's kaolin industry is obvious in the production and value data presented in table 4. However, the 1984 value reached a record high, surpassing the previous record high set in 1983 by $39.3 million.

Table 5.—Georgia: Kaolin producers in 1984[1]

| Company | Location | Capacity[2] (thousand short tons) | Major use |
|---|---|---|---|
| American Industrial Clay Co | Sandersville<br>Wrens | [3]NA | NA. |
| Anglo-American Clays Corp | Sandersville | 350 | Paper coating and filler. |
| Babcock & Wilcox Co | Hephzibah | 200 | Refractories, ceramics, fiberglass. |
| Buffalo China Clay Co | Sandersville | 55 | Paper. |
| Cyprus Industrial Minerals Co | do | 200 | Paper and refractories. |
| Engelhard Minerals & Chemicals Corp | do<br>Irwinton<br>McIntyre<br>Gardner | [3]1,000 | Paper. |
| Evans Clay Co | Irwinton | 120 | Rubber, paint, insecticide. |
| Freeport Kaolin Co | Sandersville<br>Gordon | [3]450 | Paper (80%). |
| General Refractories Co | Stevens Pottery | NA | Refractories. |
| Georgia Kaolin Co | Dry Branch | 1,600 | NA. |
| J. M. Huber Co | Wrens<br>Huber | [3]900 | Paper, rubber, plastics, paint, adhesives. |
| M & M Clays Inc | Irwinton | 80 | Rubber. |
| Nord Kaolin Co | Jeffersonville | 140 | Paper. |
| Thiele Kaolin Co | Sandersville<br>Wrens | [3]600 | Paper coating and filler. |
| Wilkinson Kaolin Associates Ltd | Gordon | 120 | Ceramics and fiberglass. |

NA Not available.

[1] Excludes Andersonville District and kaolin used in cement manufacture.

[2] Industrial Minerals (London). Dec. 1979, pp. 31-33.

[3] All pits.

Major Georgia kaolin producers, locations, capacities, and markets are given in table 5.

Several expansions and acquisitions were under way or completed during the year. Major actions are noted in the following:

| Company | Location | Remarks |
|---|---|---|
| Anglo-American Clays Corp | Sandersville | Began $8 million plant expansion. |
| Burgess Pigment Co | do | Announced plans for calciner construction. |
| Engelhard Minerals & Chemicals Corp | Attapulgus | Completed catalyst plant increasing output 30%; purchased Freeport Kaolin Co. |
| J. M. Huber Co | Huber | Completed 40,000-ton-per-year calcined kaolin facility. |
| Union Carbide Corp | Savannah | Purchased Katalistiks International BV's 50,000-ton-per-year catalyst plant. |
| United Catalysts Inc | Hephzibah | Purchased Albion Kaolin Co. |
| Wilkinson Kaolin Associates Ltd | Gordon | Completed 120,000-ton-per-year filler plant. |

In other kaolin-related action, Toth Aluminum Corp. began operating a clay carbochlorination process plant at Vacherie, LA. Kaolin, the plant feed, was shipped by rail from Georgia.

During the year, Washington County, one of the leading counties in kaolin production, developed a new procedure to classify lands under the control of producers. The method agreed on by the kaolin producers and the Washington County Board of Tax Assessors will bypass many previous tax-assessment problems and "will allow the appraisal of mineral property to be handled by the Assessors Office in a routine manner without specialized training."[6]

### Table 6.—Georgia: Kaolin sold or used by producers, by kind

| Kind | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Short tons | Value | Short tons | Value |
| Air-float | 395,422 | $21,359,864 | 591,869 | $27,989,083 |
| Calcined[1] | 770,556 | 118,769,408 | 850,372 | 129,410,496 |
| Delaminated | 722,128 | 68,527,254 | 764,566 | 72,529,476 |
| Unprocessed | 360,942 | 4,699,555 | 395,094 | 9,799,483 |
| Water-washed | 3,636,698 | 310,050,641 | 3,906,418 | 322,968,236 |
| Total | 5,885,746 | 523,406,722 | 6,508,319 | 562,696,774 |

[1] Includes both low-temperature filler and high-temperature refractory grades.

### Table 7.—Georgia: Kaolin sold or used by producers, by use

(Short tons)

| Use | 1983 | 1984 |
|---|---|---|
| Domestic: |  |  |
| Adhesives | 70,950 | 72,832 |
| Chemicals | 229,758 | 258,819 |
| Fiberglass and mineral wool | 129,129 | 168,643 |
| Firebrick, blocks and shapes | 11,308 | 7,210 |
| Floor and wall tile, ceramic | 19,931 | 20,866 |
| Paint | 112,952 | 201,787 |
| Paper coating | 2,321,663 | 2,474,575 |
| Paper filling | 994,580 | 980,283 |
| Plastics | 38,613 | 46,560 |
| Portland cement | -- | 72,700 |
| Rubber | 77,218 | 85,290 |
| Sanitary ware | 66,517 | 120,521 |
| Whiteware | 18,310 | 39,212 |
| Other | 625,833 | 618,901 |
| Exports | 1,168,984 | 1,340,120 |
| Total | 5,885,746 | 6,508,319 |

### Table 8.—Georgia: Kaolin sold or used by producers, by county

| County | 1983 |  |  | 1984 |  |  |
|---|---|---|---|---|---|---|
|  | Number of processing facilities | Quantity (thousand short tons) | Value (thousands) | Number of processing facilities | Quantity (thousand short tons) | Value (thousands) |
| Jefferson | 2 | 240 | $15,636 | 1 | W | W |
| Richmond | 2 | 133 | 11,293 | 2 | [1]269 | [1]$16,014 |
| Twiggs | 5 | 1,227 | 109,528 | 6 | 1,191 | 102,794 |
| Washington | 5 | 1,992 | 178,575 | 6 | 2,268 | 199,224 |
| Wilkinson | 6 | 902 | 99,606 | 6 | 1,164 | 123,105 |
| Other[2] | 7 | 1,391 | 108,769 | 7 | 1,616 | 121,560 |
| Total | 27 | [3]5,886 | 523,407 | 28 | 6,508 | 562,697 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes Jefferson County.

[2] Includes Columbia, Houston, Sumter, and Warren Counties and data indicated by symbol W.

[3] Data do not add to total shown because of independent rounding.

*Fuller's Earth.*—Output fell 123,000 short tons below the record high established in 1983. The industry was comprised of five companies in southwest Georgia and a sixth in the central part of the State.

Fuller's earth was mined by surface methods and trucked to a processing facility where the ore was dried, crushed, milled, screened, and bagged.

Table 9.—Georgia: Fuller's earth producers in 1984

| Company | Location | Product |
|---|---|---|
| Engelhard Minerals & Chemicals Corp | Attapulgus | Catalysts and absorbents. |
| GA-TN Mining and Chemical Co | Wrens | Absorbents (animal and industrial wastes) and agricultural carriers. |
| Milwhite Co. Inc | Attapulgus | Absorbents, fillers, joint compounds. |
| Oil-Dri Corp | Ocklocknee | Absorbents (animal and industrial wastes). |
| Thor Mining Co | Meigs | Do. |
| Waverly Mineral Products Co | do | Do. |

Table 10.—Georgia: Fuller's earth sold or used by producers, by kind

(Thousand short tons and thousand dollars)

| Kind | 1982 |  | 1983 |  | 1984 |  |
|---|---|---|---|---|---|---|
|  | Quantity | Value | Quantity | Value | Quantity | Value |
| Attapulgite | 295 | 15,763 | 497 | 23,571 | 364 | 23,602 |
| Montmorillonite | 289 | 11,794 | 195 | 9,254 | 205 | 8,813 |
| Total[1] | 584 | 27,558 | 692 | 32,826 | 569 | 32,415 |

[1] Data may not add to totals shown because of independent rounding.

*Common Clay.*—Production and value of products fabricated from clay and shale increased for the second consecutive year. This was due to the strong demand for building materials from the State's construction industry. Data on Georgia's construction industry are presented in table 3.

The common clay and shale industry has operations in four counties in the northwest and two counties in central and east-central Georgia. Summary statistics on the industry are given in table 11. Most of Georgia's common clay and shale production is used in brick production. From 1982 to 1984, 86%, 80%, and 85%, respectively, were used in brick manufacture. Other leading uses included aluminum sulfate and portland cement manufactures.

During the year, Florida Tile Industries Inc., a division of Sikes Corp., completed a $7 million expansion at its Shannon manufacturing facility. The expansion, which followed the installation of a third production line, increased production capacity by 50%.[7]

Table 11.—Georgia: Common clay production in 1984, by selected area and county

| Area and county | Number |  | Production |  |
|---|---|---|---|---|
|  | Companies | Mines | Quantity (thousand short tons) | Value (thousands) |
| Northwest: Bartow, Douglas, Floyd, Fulton | 5 | 6 | 710 | $2,614 |
| Central and east: Bibb, Columbia, Richmond | 5 | 11 | 891 | 2,304 |

**Feldspar.**—Georgia ranked third behind North Carolina and Connecticut in the production of feldspar, an aluminum silicate used in glassmaking and ceramics. The Feldspar Corp., a subsidiary of Pacific Tin Consolidated Corp., the Nation's largest producer, operated surface mines in Greene and Jasper Counties and a beneficiation plant at Monticello in Jasper County. The Greene County mine is developed in a granite saprolite with high-potash feldspar ore, while the Jasper County operation produces soda feldspar ore from pegmatite. At the Monticello facility, material from both mines was crushed, ground, and a feldspar concentrate obtained by flotation. The concentrate was bagged and shipped to customers in over 20 States, Canada, and

Mexico. Production increased for the second consecutive year, principally because of increased demand for flat glass and whiteware for the construction industry. Feldspar use within the State has risen from 64,700 short tons in 1980 to 96,000 tons in 1984. The principal market is glass production in the Atlanta area.

**Gypsum.**—Three companies imported gypsum from Canada to manufacture gypsum board, plasters, fillers, and agricultural products. American Cyanamid Co. produced byproduct gypsum during titanium dioxide production at Savannah. Lemco Gypsum Inc. purchased gypsum from American Cyanamid for briquet manufacture for the cement industry. Georgia gypsum importers/users are as follows:

| Company | County | Source |
|---|---|---|
| Genstar Building Products Co. | Chatham | Newfoundland. |
| Georgia-Pacific Corp., Gypsum Div. | Glynn__ | Nova Scotia. |
| Goldbond Building Materials Corp. | Chatham | Do. |
| Lemco Gypsum Inc __ | ____do | American Cyanamid Co. |

**Kyanite-Mullite.**—The production of kyanite, an aluminum silicate used by the ceramic industry and as a raw material in the production of mullite for refractory applications, was restricted to Georgia and Virginia.

In Lincoln County, C-E Minerals Inc. operated an open pit kyanite mine and beneficiation plant at Graves Mountain. The operation utilizes grinding, two-stage flotation, and magnetic separation to produce a kyanite concentrate. The operation was sold to Pasco Mining Co. in December. The company continued to supply kyanite to the refractories industry.

**Iron Oxide Pigments.**—New Riverside Ochre was Georgia's only iron oxide pigment producer. The Cartersville-based company mined crude pigments from lower Cambrian Age rocks; most of the pigments were processed into coloring agents for cement and construction materials. During the year, the company conducted a limited exploration program to ensure customers of an uninterrupted supply of pigment material.

**Mica.**—Franklin Mineral Products operated an open pit mine and a beneficiation and wet grinding plant in Hart County in northeast Georgia. The company, a division of the Mearl Corp., also imported mica for grinding. Some crude mica was trucked to a company-owned wet grinding plant in Franklin, NC. Much of the production was used by the parent company for pearlescent pigment manufacture.

**Perlite.**—Armstrong World Industries Inc. imported crude perlite from Greece for expanding at a plant in Macon. Sales, primarily for use in insulation, were below the 1983 level.

**Sand and Gravel.**—In 1984, Georgia's sand and gravel industry consisted of 50 companies operating 51 mines for the production of construction sand and gravel and 4 companies operating 4 mines for industrial sand and gravel production. Production and value of construction sand and gravel increased over 1983 levels, while industrial sand and gravel output and value fell.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numberod years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

The State's construction sand and gravel industry was reported in 3 principal areas, in 11 counties in the Piedmont, in a belt of 6 counties along the Piedmont-Coastal Plain border (fall line), and in 13 Coastal Plain counties.

**Table 12.—Georgia: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,094 | $8,415 | $2.72 |
| Plaster and gunite sands | 262 | 669 | 2.56 |
| Concrete products | 137 | 367 | 2.68 |
| Asphaltic concrete | 55 | 118 | 2.14 |
| Road base and coverings | 56 | 71 | 1.28 |
| Fill | 331 | 478 | 1.45 |
| Other[1] | 1,418 | 3,506 | 2.48 |
| Total[2] or average | 5,347 | 13,628 | 2.55 |

[1] Includes other unspecified uses.

[2] Data may not add to totals shown because of independent rounding.

*Industrial.*—Georgia's industrial sand and gravel industry is situated in three central Georgia Counties, Crawford, Long, and Marion, and in the southwestern part of the State in Thomas County. Four companies produced sand for, in descending order of value, (1) glass container manufacture, (2) unspecified, (3) sandblasting, (4) molding, (5) roofing, and (6) filtration. Production declined 61,000 short tons, which represented a $503,000 decrease in value.

**Silicon Carbide.**—Silicon Metal Products Inc. operated the country's only plant to recover silicon carbide from granite cutting sludge. The Elberton-based firm used waste material from the dimension granite cutting and finishing operation as plant feed, recovering silicon carbide concentrate by flotation. Recovery was enhanced by flotation research conducted by the U.S. Bureau of Mines Tuscaloosa Research Center.

**Slag—Iron and Steel.**—Atlantic Steel Co. plants in Atlanta and Cartersville produced slag as a byproduct of steelmaking. The slag was sold to a firm that markets the material as an aggregate.

**Sodium Bicarbonate.**—In June, Riverside Products of Cartersville began operating a sodium bicarbonate plant, the only bicarbonate producer in the Southeast. Raw material for the over-20,000-short-ton-per-year facility, soda ash produced from trona, was shipped from Wyoming. Sodium bicarbonate is preduced by reacting soda ash, water, and carbon dioxide; the resulting precipitate is dewatered, washed, dried, and screened. Major markets are the pharmaceutical, food, and animal feed industries. The company, a sister company of Chemical Products, a barium and strontium chemical producer, was incorporated in December 1982.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Georgia's stone producers market a variety of stone types and products: crushed granite, limestone, and quartzite for aggregate applications; crushed limestone and marl for cement manufacture; ground marble for extenders and fillers and for agricultural applications; crushed slate for lightweight aggregate production; dimension granite for monumental and structural panel fabrication; and flagstone and rubble for a variety of building applications.

*Crushed.*—The crushed stone industry was primarily in the northern part of the State. The granite sector was in the north-central and northeast, limestone and slate in the northwest, marble in Gilmer and Pickens County in north Georgia, and quartzite in Richmond County in east-central Georgia. Tertiary limestone-marl was mined in Houston, Lee, and Miller Counties in the southern part of the State.

Although statistics are not available for precise numerical ranking, Georgia ranks high in the Nation in the production of ground marble for extender and filler applications. Georgia Marble Co. operated four underground room-and-pillar mines in the Murphy Marble Belt of Gilmer and Pickens County. Both dry and wet grinding are used to produce several dozen products.

*Dimension Granite.*—Georgia produced 28% of the dimension granite quarried in the United States and continued as the leading granite producing State. The Elberton District in northeast Georgia again was the leading dimension granite producing area. The principal quarrying areas are Elbert, Madison, and Oglethorpe Counties; over 35 quarries are in operation within a 25-mile radius of Elberton. Much of the production is shipped by truck to the Port of Savannah and then shipped to overseas markets.

*Dimension Marble.*—The Long Swamp Valley in Pickens County is the site of Georgia Marble's Tate Quarries, and for many years the company has led the Nation in marble output. The company's Memorial Div., located at the quarry site, fabricated markers, mausoleums, and personal monuments; the Structural Div. at Nelson fabricated panels for interiors and facades.

*Other Dimension Stone.*—Several north Georgia firms produced a variety of metamorphic rock for flagstone applications. Metagraywacke, the principal stone quarried, is used in exterior and interior applications in both residential and commercial construction.

**Strontium Compounds.**—Chemical Products imported celestite from Mexico; the strontium sulfate mineral is used in the production of strontium carbonate for the television picture tube faceplates market and other specialty applications. Chemical Products is the only remaining major U.S. producer of strontium carbonate.

The company also processed barite produced by New Riverside Ochre for barium chemical production.

**Talc.**—Murray County in north-central Georgia is the site of Southern Talc Co.'s Rock Cliff Mine. The crude talc was trucked to the company's mill in Chatworth where it was dried, crushed, and ground for sale to the ceramics, insecticide, paper, roofing, and rubber markets.

**Titanium Dioxide.**—American Cyanamid produced titanium dioxide pigment at its Savannah plant, which uses both the sulfate and chloride processes. Principal markets were the paint, paper, and plastic industries.

American Cyanamid was negotiating with NL Industries Inc. for the sale of the 110,000-short-ton-per-year Savannah facility. However, NL later announced that it would not pursue this acquisition because of opposition by the Federal Trade Commission.

## METALS

**Arsenic.**—High-purity arsenic trioxide was produced by Koppers Co. Inc. at a plant in Conley. Raw material was obtained from the roasting of gold ores from two Canadian producers. The arsenic trioxide was processed into arsenic acid for the manufacture of chromated copper arsenate wood preservative.

**Bauxite.**—The U.S. bauxite industry is in Alabama, Arkansas, and Georgia. In Georgia, production was from the Andersonville bauxite district in the southwestern part of the State where the Mulcoa Div. of C-E Minerals operated a surface mine and processing facility. The bauxite is used in the manufacture of refractory grogs.

**Copper.**—Southwire Co. operated a copper smelter, a continuous cast copper rod plant, and a copper wire facility. The company's facilities are at Carrollton, west of Atlanta.

**Gold.**—During 1984, five companies in White and Lumpkin Counties were active in gold mining. Most of the northeastern Georgia operations were locally owned, although one company in White County was controlled by a group of Mississippi investors operating under the name of Satellite Energy Inc. The largest operation, Tahloneka Resources Inc., opened in midyear on a 107-acre site near Cleveland.

Draglines and front-end loaders were commonly used for stripping and mining, and metal trommel screens and sluices replaced the wooden varieties prevalent in the district a century earlier. Most of the operations sell byproduct sand and gravel to help meet expenses.

**Iron and Steel.**—Atlantic Steel operated a minimill in Atlanta and one in Cartersville. The Atlanta mill was equipped with two 90-short-ton electric furnaces and bar, rod, and wire plants; the Cartersville mill was equipped with a 100-ton electric furnace and bar facility.

**Platinum.**—Tetronics Research and Development Co. Ltd., Faringdom, Oxom, England, constructed a plant in the Atlanta area for Texasgulf Inc. The plant was designed to process 11,000 tons per year of used automobile catalytic converters for the extraction of platinum.

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] Senior economic geologist, Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources.

[3] Atlanta Journal. Bill Would Insure That Strip-Mined Land is Restored. Jan. 30, 1984.

[4] Sandersville Progress. Committee Studies Reclamation. Aug. 16, 1984.

[5] Atlanta Journal. Court Allows Truck Weight Exemption. Feb. 3, 1985.

[6] Sandersville Progress. Clay Property Categories Up Evaluations. Sept. 7, 1984.

[7] Ceramic Industry. Florida Tile Starts Addition to Plant. V. 122, No. 2, Feb. 1984, p. 10.

## Table 13.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Barite: | | | |
| New Riverside Ochre Co.[1] | Box 387<br>Cartersville, GA 30120 | Open pit mine and mill. | Bartow. |
| Paga Mining Co | Box 130<br>Cartersville, GA 30120 | do | Do. |
| Bauxite: | | | |
| Mullite Co. of America | Box 37<br>Andersonville, GA 31711 | do | Do. |
| Cement: | | | |
| Blue Circle Inc | 15 South 20th St.<br>Birmingham, AL 35233 | Plant | Fulton. |
| Medusa Cement Co | Box 5668<br>Cleveland, OH 44101 | do | Houston. |
| Clays: | | | |
| American Industrial Clay Co | 433 North Broad St.<br>Elizabeth, NJ 07207 | Open pit mines. | Warren and Washington. |
| Engelhard Minerals & Chemicals Corp. | Menlo Park<br>Edison, NJ 08817 | do | Decatur, Washington, Wilkinson. |
| J. M. Huber Co | Thornall St.<br>Edison, NJ 08817 | do | Twiggs and Warren. |
| Thiele Kaolin Co | Box 1056<br>Sandersville, GA 31082 | do | Warren and Washington. |
| Feldspar: | | | |
| The Feldspar Corp | Box 99<br>Spruce Pine, NC 28777 | Open pit mines and plant. | Greene and Jasper. |
| Gypsum (calcined): | | | |
| Genstar Building Products Co | Box 2580<br>Irving, TX 75061 | Plant | Chatham. |
| Georgia-Pacific Corp | 133 Peachtree St., NE.<br>Atlanta, GA 30303 | do | Glynn. |
| National Gypsum Co | 4100 First International Bldg.<br>Dallas, TX 75270 | do | Chatham. |
| Kyanite: | | | |
| Pasco Mining Co | Box 649<br>Washington, GA 30673 | Open pit mine and plant. | Lincoln. |
| Mica: | | | |
| Franklin Mineral Products, a division of Mearl Corp. | 635 Main St.<br>Wilmington, MA 01887 | do | Hart. |
| Perlite (expanded): | | | |
| Armstrong World Industries Inc | 1010 Concord<br>Lancaster, PA 17604 | Plant | Bibb. |
| Sand and gravel: | | | |
| Construction: | | | |
| Atlanta Sand & Supply Co | Route 1<br>Roberta, GA 31078 | Open pit mine | Crawford. |
| Brown Bros. Sand Co | Box 82<br>Howard, GA 31039 | Open pit mines. | Talbot. |
| Howard Sand Co | Box 118<br>Butler, GA 31006 | do | Talbot and Taylor. |
| Industrial: | | | |
| Crawford County Mining Inc | Route 1<br>Roberta, GA 31078 | Open pit mine | Crawford. |
| L. C. Curtis & Son Inc | Box 123<br>Watkinsville, GA 30677 | do | Greene. |
| Montgomery Sand Co., a subsidiary of Florida Crushed Stone Co. | Box 2117<br>Thomasville, GA 31792 | do | Thomas. |
| Jesse S. Morie & Son Inc | 1201 North High St.<br>Millville, NJ 08332 | do | Marion. |
| Stone: | | | |
| Crushed: | | | |
| Florida Rock Industries Inc | Box 4667<br>Jacksonville, FL 32201 | Quarries | Clayton, Fayette, Floyd, Monroe, Spalding. |
| Georgia Marble Co | 2575 Cumberland Pkwy., NW.<br>Atlanta, GA 30339 | do | Cherokee, De Kalb, Douglas, Forsyth, Gilmer, Hall, Newton, Pickens. |
| Martin Marietta Aggregates | Box 30013<br>Raleigh, NC 27612 | do | Jones, Lee, Richmond, Warren. |

See footnotes at end of table.

## Table 13.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Stone —Continued | | | |
| Crushed —Continued | | | |
| North Georgia Crushed Stone Co., a division of Koppers Co. Inc. | Box 468<br>Lithonia, GA 30058 | Quarries ___ | Clarke,<br>De Kalb,<br>Fayette,<br>Fulton,<br>Habersham,<br>Hall,<br>Stephens,<br>Walker. |
| Vulcan Materials Co ________ | Box 80730<br>Atlanta, GA 30366 | ____do____ | Carroll,<br>Cobb,<br>Coweta,<br>Douglas,<br>Fulton,<br>Gwinnett,<br>Henry,<br>Troup. |
| Dimension: | | | |
| Bennie & Harvey Inc________ | Box 958<br>Elberton, GA 30635 | Quarry and finishing plant. | Oglethorpe. |
| Coggings Granite Industries Inc _ | Box 250<br>Elberton, GA 30635 | ____do____ | Madison. |
| Georgia Marble Co _________ | 2575 Cumberland Pkwy., NW.<br>Atlanta, GA 30339 | ____do____ | Pickens. |
| Granite Panewall Co., a division of Florida Crushed Stone Co. | Box 898<br>Elberton, GA 30635 | ____do____ | Elbert. |
| Talc: | | | |
| Southern Talc Co_____________ | Box F<br>Chatsworth, GA 30705 | Mines and mill. | Murray. |

[1] Also produced crude iron oxide pigments.

# The Mineral Industry of Hawaii

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Department of Land and Natural Resources of the State of Hawaii for collecting information on all nonfuel minerals.**

## By Herbert R. Babitzke[1]

Hawaii's nonfuel mineral production value decreased slightly in 1984 to $51 million, down from the $52 million recorded in 1983, and 20% less than that from the record high year of 1979. The nonfuel mineral industry in the State is largely dependent on construction. A protracted strike by the building trade unions, beginning in midyear, resulted in a substantial decline in the total volume of construction over the year, with a corresponding decrease in the quantity of minerals produced. An improvement in the construction industry, primarily owing to yearend seasonal expansion, was noted late in 1984.

Nonmetals—cement, gem stones, lime, pumice, sand and gravel, and stone—accounted for the total mineral value. All of the industrial minerals except gem stones and lime were used by the construction industry. Hawaii ranked 44th in the Nation in value of nonfuel minerals produced in 1984, identical to the ranking attained in 1983.

Construction continued on the deep-draft harbor at Barbers Point, which will serve as a second commercial port for Oahu; completion is scheduled for June 1985. The construction required the removal of 10 million cubic yards of coral, which was being stockpiled on the Campbell Industrial Park for eventual sale for road construction aggregate, concrete aggregate, and for agricultural purposes.

**Table 1.—Nonfuel mineral production in Hawaii[1]**

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Cement: | | | | |
| Masonry thousand short tons | 6 | $641 | 5 | $792 |
| Portland do. | 216 | 20,673 | 186 | 18,282 |
| Sand and gravel (construction) do. | [e]440 | [e]1,000 | 436 | 2,031 |
| Stone: | | | | |
| Crushed do. | 5,532 | 29,703 | [e]5,400 | [e]29,700 |
| Dimension do. | (2) | 3 | -- | -- |
| Combined value of gem stones, lime, and pumice | XX | 391 | XX | 442 |
| Total | XX | 52,411 | XX | 51,247 |

[e] Estimated. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Less than 1/2 unit.

## Table 2.—Value of nonfuel mineral production in Hawaii, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Hawaii | W | W | Stone (crushed), pumice, stone (dimension). |
| Honolulu | W | $42,012 | Stone (crushed), cement. |
| Kauai | $78 | 2,100 | Stone (crushed). |
| Maui | 1,344 | 1,291 | Stone (crushed), lime, pumice. |
| Undistributed[2] | W | 6,007 | |
| Sand and gravel (construction) | XX | [e]1,000 | |
| Stone: | | | |
| Crushed | [e]26,600 | XX | |
| Dimension | [e]4 | XX | |
| Total | 46,889 | 52,411 | |

[e] Estimated. W Withheld to avoid disclosing company proprietary data; included in "Total" for 1982 and "Undistributed" for 1983. XX Not applicable.

[1] County distribution for crushed and dimension stone (1982) and construction sand and gravel (1983) is not available; total State values are shown separately under "Sand and gravel (construction)" or "Stone."

[2] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

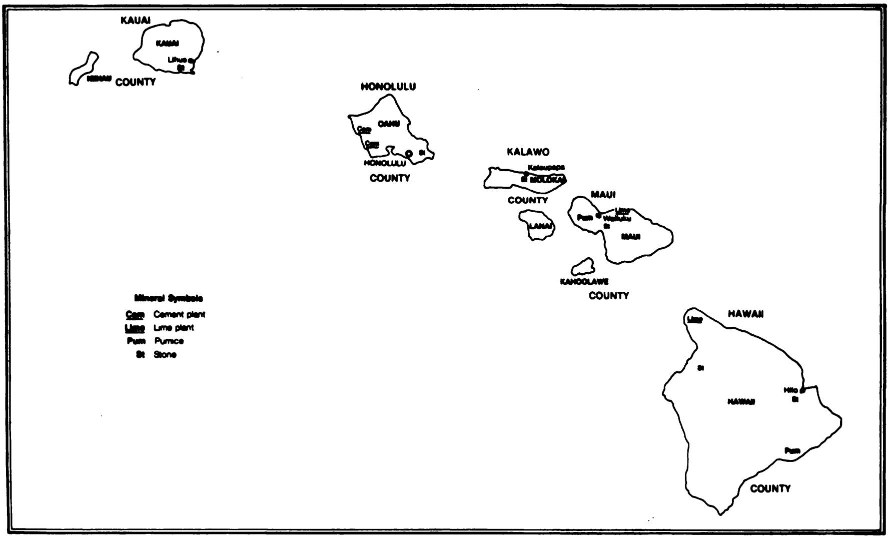

Figure 1.—Principal mineral producing localities in Hawaii.

Of major concern to Hawaii was the Law of the Sea controversy. The United States declined to sign the treaty, based on objections to its provisions regarding seabed mining within international waters. Seabed mining within national economic zones was another matter; the Federal Government claimed a 200-mile offshore Exclusive Economic Zone (EEZ). The EEZ may become significant to Hawaii because it conceivably could facilitate seabed mining in offshore waters. A joint Federal-State task force was formed in February to consider the economic potential and environmental impact of ocean mining of cobalt-rich manganese crusts in the 200-mile zone surrounding the Hawaiian archipelago. Hawaii's Governor said, however, that the U.S. Department of the Interior was responsible for exploring and developing ways to mine the ocean bottom. Later in the year, Interior's Minerals Management Service granted the State of Hawaii $1.8 million to conduct a search for cobalt on its seamount slopes. Recent findings by the U.S. Geological Survey of large concentrations of manganese crusts are again raising some expectations that Hawaii may still play a role in developing the Pacific's mineral resources. The possibility of the State becoming a center for seabed mining could lead to diversification of the State's economy

## Table 3.—Indicators of Hawaii business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 997 | 1,018 | 1,039 |
| Total civilian labor force | do | 460.0 | 472.0 | 473.0 |
| Unemployment | do | 31.0 | 30.0 | 27.0 |
| Employment (nonagricultural): | | | | |
| Mining total | do | .1 | .1 | .1 |
| Nonmetallic minerals except fuels | do | .1 | .1 | .1 |
| Manufacturing total | do | 22.4 | 22.4 | 21.8 |
| Primary metal industries[1] | do | .1 | (2) | NA |
| Stone, clay, and glass products | do | 1.2 | 1.1 | 1.0 |
| Chemicals and allied products[1] | do | .5 | .5 | NA |
| Petroleum and coal products[1] | do | .5 | .5 | NA |
| Construction | do | 17.9 | 17.8 | 16.1 |
| Transportation and public utilities | do | 31.2 | 31.1 | 31.9 |
| Wholesale and retail trade | do | 104.8 | 106.8 | 110.6 |
| Finance, insurance, real estate | do | 31.5 | 31.9 | 31.9 |
| Services | do | 101.2 | 104.9 | 108.5 |
| Government and government enterprises | do | 90.3 | 91.3 | 91.7 |
| Total[3] | do | 399.4 | 406.2 | 412.5 |
| Personal income: | | | | |
| Total | millions | $11,604 | $12,570 | $13,547 |
| Per capita | | $11,642 | $12,345 | $13,042 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 37.9 | 38.6 | 38.1 |
| Total average hourly earnings, production workers | | $7.97 | $8.23 | $8.35 |
| Earnings by industry: | | | | |
| Farm income | millions | $262 | $264 | $298 |
| Nonfarm | do | $8,257 | $8,907 | $9,520 |
| Mining total | do | $2 | $2 | $1 |
| Nonmetallic minerals except fuels | do | $1 | $2 | $1 |
| Oil and gas extraction | do | (4) | (4) | (4) |
| Manufacturing total | do | $431 | $450 | $459 |
| Primary metal industries | do | $2 | $2 | $1 |
| Stone, clay, and glass products | do | $35 | $34 | $30 |
| Chemicals and allied products | do | $11 | NA | NA |
| Petroleum and coal products | do | $22 | $23 | $25 |
| Construction | do | $493 | $546 | $503 |
| Transportation and public utilities | do | $790 | $809 | $873 |
| Wholesale and retail trade | do | $1,322 | $1,400 | $1,525 |
| Finance, insurance, real estate | do | $552 | $631 | $669 |
| Services | do | $1,771 | $1,980 | $2,201 |
| Government and government enterprises | do | $2,864 | $3,048 | $3,248 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 5,790 | 4,760 | 5,400 |
| Value of nonresidential construction | millions | $250.3 | $117.8 | $139.2 |
| Value of State road contract awards | do | $69.0 | $77.3 | $45.9 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 235 | 222 | 191 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $46.9 | $52.4 | $51.2 |
| Value per capita | | $47 | $51 | $49 |

[p] Preliminary. [r] Revised. NA Not available.
[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2] Less than 50 employees.
[3] Data may not add to totals shown because of independent rounding.
[4] Less than 1/2 unit.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Cement.**—Kaiser Cement Corp. at Waianae and Lone Star Hawaiian Cement Corp. at the Campbell Industrial Park operated the two cement plants in Honolulu County (Oahu). Combined annual capacity for both plants is approximately 600,000 short tons of cement. The plants produced at about 32% of capacity in 1984, compared with 36% of capacity in 1983. Sales of portland cement declined by 14% from those of 1983. Masonry cement sold during the year was 5,497 short tons, a decrease of about 10% from the 1983 quantity; value, however, was up 24% to about $792,000 in 1984.

Of the total portland cement sold, 72% was used in ready-mix concrete, 13% by concrete-product manufacturers, 7% by building-material dealers, 7% by other contractors, and 1% by government agencies and miscellaneous customers. No sales to highway contractors were reported for 1984.

Raw materials consumed in portland cement manufacture were limestone, coral, volcanic cinder, sandstone, sand, pyrite, and gypsum. Kilns at both plants were fired with fuel oil and coal, and electrical energy was purchased for each. As in previous years, all of the limestone, coral, and volcanic cinder were mined at nearby quarries on Oahu; other raw materials were imported, either from Australia or Mexico. Coal was imported from Australia.

Ameron Honolulu Construction & Drayage Ltd. (Ameron HC&D) doubled the capacity of its concrete pipe manufacturing facility at Barbers Point on Oahu. The company produced concrete cylinder pipe, vertically cast and horizontally spun reinforced concrete pipe, and machine-made concrete pipe.

**Gem Stones.**—Supported by expanding tourism and a steady local market, the Hawaiian semiprecious gem stone industry continued to draw considerable interest in 1984. Coral in the favored "angelskin" pink and black colors, and in less desirable red and gold tones, was taken by divers from nearshore coral beds. Olivine (peridot) was recovered from volcanically derived sources. These semiprecious gem stones were used by the local jewelry industry.

**Lime.**—The Hawaiian Commercial & Sugar Co. Ltd. produced quicklime and hydrated lime from its calcining operations near Paia in Maui County. Brewer Chemical Corp. continued to produce fine-ground calcium carbonate at Kawaihae in Hawaii County for sale as agricultural soil conditioner; the raw limestone was produced from local harbor dredging operations.

Reported lime production in Hawaii decreased 25% in quantity and almost 16% in value from that of 1983.

**Pumice and Pumicite.**—Pumice and pumicite production in Hawaii increased 12% in quantity and 6% in value over that of 1983. Pumice was mined by the Puna Sugar Co. Ltd. at Keeau and by Volcanite Ltd. at Kailua Kona in Hawaii County; pumicite (volcanic ash) was mined by Maui Pineapple Co. Ltd. at Lahaina in Maui County. Principal uses were for concrete aggregate and in landscaping; lesser uses were for insulation and in road construction and maintenance.

**Sand and Gravel.**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on estimates made before yearend.

The 1984 output of construction sand and gravel in the State decreased 3%, but the value increased 66% over that reported for 1982, when the last complete canvass was taken. Average unit value for all use categories increased 71% over that of 1982. Five companies reported sand and gravel production in 1984, each producing from a single owned or leased pit. Amelco Corp. produced in Maui County; Kauai Sand & Gravel Inc., Lihue Plantation Co. Ltd., and Kekaha Sugar Co. Ltd. produced in Kauai County; and Hamakua Sand & Gravel produced in Hawaii County. Kauai Sand & Gravel on Kauai was the major sand and gravel producer, with Amelco ranking second. The distribution of the major use categories is given in table 4. All sand and gravel produced was transported by truck.

**Table 4.—Hawaii: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value (per ton) |
|---|---|---|---|
| Concrete aggregate | W | W | $9.00 |
| Asphaltic concrete | W | W | 6.00 |
| Road base and coverings | W | W | 3.70 |
| Other | 436 | $2,031 | 4.66 |
| Total or average | 436 | 2,031 | 4.66 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Ameron HC&D, a major producer of crushed stone products, was the principal supplier of concrete and concrete products to the State's construction industry. A variety of crushed stone products, ranging from coarse aggregate to a sand-size fraction, was produced at the company's Kaapa quarry crushing operation on Oahu. Sand production from crushing has been essential to the construction industry since the prohibition of beach sand mining several years ago. Ameron HC&D announced plans during the year for a 152-acre expansion of the Kaapa quarry. If the plan is carried out, the company would be able, starting in 1988, to mine 650,000 tons of rock per year through the year 2012; opposition to the expansion was voiced by an environmental group.

Kauai Sand & Gravel received approval from the Kauai Planning Commission to construct asphalt and concrete batching plants at its Hanamaulu Valley quarry on the island of Kauai.

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[1] State Mineral Officer, Bureau of Mines, Spokane, WA.

### Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Kaiser Cement Corp | Waianae Plant<br>300 Lakeside Dr.<br>Oakland, CA 94612 | Cement plant | Honolulu. |
| Lone Star Hawaiian Cement Corp | Hawaii Plant<br>91-055 Kaomi Loop<br>Ewa Beach, HI 96706 | do | Do. |
| Lime: | | | |
| Hawaiian Commercial & Sugar Co. Ltd. | Box 266<br>Puunene, HI 96784 | Rotary kiln and continuous hydrator. | Maui. |
| Pumice: | | | |
| Volcanite Ltd | Box 3000<br>Kailua Kona, HI 96740 | Surface mine | Hawaii. |
| Sand and gravel: | | | |
| Amelco Corp., Maui Concrete | Box 488<br>Kahului, HI 96732 | Plant and pit | Maui. |
| Kauai Sand & Gravel Inc | 4247 Kapaia Rd.<br>Lihue, HI 96766 | do | Kauai. |
| Stone: | | | |
| Ameron Honolulu Construction & Drayage Ltd. | Box 29968<br>Honolulu, HI 96820 | Quarries | Honolulu and Maui. |
| Grove Farm Rock Co. Inc | Puhi Rural Station<br>Lihue, HI 96776 | do | Kauai. |
| Lone Star Hawaii Rock Products | 11555 Dublin Canyon Rd.<br>Pleasanton, CA 94566 | Quarry | Honolulu. |
| Pacific Concrete & Rock Co. Ltd | 2344 Pahounui Dr.<br>Honolulu, HI 96819 | Quarries | Honolulu and Maui (Molokai). |

# The Mineral Industry of Idaho

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Idaho Geological Survey, University of Idaho, for collecting information on all nonfuel minerals.**

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Idaho's nonfuel mineral production value decreased slightly in 1984 to $412 million, down from the $415 million recorded in 1983. The first full year of molybdenum production in the State and an improved year in the phosphate industry were not sufficient to offset decreases in the value of silver production because of lower silver prices.

Silver continued to be the leading commodity in terms of value, followed by phosphate rock, molybdenum, and gold. Metallic minerals accounted for 59% of total nonfuel mineral value for the year; silver accounted for 63% of that total. Idaho ranked 21st in the Nation in value of nonfuel minerals produced in 1984, down from the 17th ranking achieved in 1983.

The Cyprus Thompson Creek molybdenum mine west of Challis in Custer County accomplished its first full year of production in 1984; by yearend, the operation had achieved 75% of capacity, producing about 50 tons of molybdenite concentrates per day.

**Table 1.—Nonfuel mineral production in Idaho[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Antimony ore and concentrate, antimony content short tons | 585 | W | 557 | W |
| Clays thousand short tons | 6 | $91 | [2]1 | $243 |
| Copper (recoverable content of ores, etc.) metric tons | 3,556 | 6,000 | 3,701 | 5,455 |
| Gem stones | NA | 100 | NA | 150 |
| Lead (recoverable content of ores, etc.) metric tons | [r]25,893 | [r]12,376 | W | W |
| Lime thousand short tons | 85 | 7,686 | 87 | 5,616 |
| Phosphate rock thousand metric tons | W | W | 4,722 | 126,586 |
| Sand and gravel (construction) thousand short tons | [e]3,000 | [e]9,800 | 4,725 | 13,509 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 17,684 | 202,308 | 18,869 | 153,608 |
| Stone (crushed) thousand short tons | 1,935 | 7,480 | [e]1,800 | [e]7,100 |
| Combined value of cement, garnet (abrasive), gold, gypsum, molybdenum (1984), perlite, pumice, sand and gravel (industrial), stone (dimension), tungsten ore and concentrate (1983), vanadium, zinc, and values indicated by symbol W | XX | 169,318 | XX | 100,028 |
| Total | XX | [r]415,159 | XX | 412,295 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes bentonite and fire clay.

## Table 2.—Value of nonfuel mineral production in Idaho, by county[1]

(Thousands)

| County | 1982 | 1983[2] | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Ada | $800 | W | Silver, gold, lead. |
| Adams | -- | $30 | Stone (crushed), silver, copper. |
| Bannock | W | W | Cement, stone (crushed). |
| Bear Lake | -- | (3) | Lead, silver. |
| Benewah | W | W | Garnet (abrasive), stone (crushed). |
| Bingham | 18,091 | W | Phosphate rock. |
| Blaine | W | W | Silver, stone (crushed), gold, copper, lead. |
| Boise | -- | 1 | Stone (crushed). |
| Bonner | W | W | Silver. |
| Bonneville | W | W | Stone (dimension), pumice, stone (crushed). |
| Boundary | 70 | 54 | Stone (crushed). |
| Butte | W | (3) | Do. |
| Camas | W | W | Silver, gold, lead. |
| Canyon | W | 1,527 | Lime. |
| Caribou | W | 99,032 | Phosphate rock, vanadium, stone (crushed). |
| Cassia | W | W | Stone (dimension), stone (crushed). |
| Clark | W | 131 | Stone (crushed), clays. |
| Clearwater | (4) | 83 | Stone (crushed). |
| Custer | 653 | 2,301 | Silver, lead, copper, gold, stone (crushed). |
| Elmore | W | 18 | Stone (crushed). |
| Franklin | (4) | 117 | Do. |
| Fremont | 45 | 7 | Do. |
| Gem | 1,694 | W | Sand and gravel (industrial). |
| Gooding | W | -- | |
| Idaho | W | 1,498 | Stone (crushed), gold. |
| Kootenai | W | 6 | Stone (crushed). |
| Latah | W | W | Stone (crushed), clays. |
| Lemhi | W | 22 | Stone (crushed), gold, silver, lead. |
| Lewis | (4) | 310 | Stone (crushed). |
| Madison | W | -- | |
| Minidoka | W | 4,389 | Lime. |
| Nez Perce | 430 | 285 | Stone (crushed). |
| Oneida | W | W | Perlite, pumice. |
| Owyhee | W | W | Silver, gold. |
| Power | 6 | -- | |
| Shoshone | 128,863 | 204,311 | Silver, lead, copper, gold, antimony, zinc. |
| Twin Falls | W | W | Lime, stone (crushed). |
| Valley | W | W | Gold, silver, stone (crushed), tungsten. |
| Washington | W | W | Gypsum, stone (crushed). |
| Undistributed[5] | [r]146,655 | 91,237 | |
| Sand and gravel (construction) | XX | [e]9,800 | |
| Stone: | | | |
| Crushed | [e]6,000 | XX | |
| Dimension | W | XX | |
| Total | [r] [6]303,309 | 415,159 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Less than 1/2 unit.

[4] Crushed or dimension stone was produced; data not available by county. Total State value is shown separately under "Stone."

[5] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[6] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Idaho business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 977 | 987 | 1,001 |
| Total civilian labor force | do. | 444 | 458 | 464 |
| Unemployment | do. | 44 | 45 | 33 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do. | 3.8 | 4.1 | 4.0 |
| Metal mining | do. | 2.5 | 2.6 | 2.7 |
| Nonmetallic minerals except fuels[2] | do. | 1.1 | 1.3 | NA |
| Oil and gas extraction[2] | do. | .2 | .2 | NA |
| Manufacturing total | do. | 47.8 | 51.4 | 54.2 |
| Primary metal industries[2] | do. | .2 | .1 | NA |
| Stone, clay, and glass products | do. | .9 | 1.0 | .9 |
| Chemicals and allied products | do. | NA | 3.3 | 3.5 |
| Construction | do. | 13.8 | 13.2 | 12.8 |
| Transportation and public utilities | do. | 19.1 | 19.1 | 19.0 |
| Wholesale and retail trade | do. | 78.0 | 79.4 | 82.3 |
| Finance, insurance, real estate | do. | 22.7 | 23.0 | 23.5 |
| Services | do. | 59.3 | 59.9 | 61.6 |
| Government and government enterprises | do. | 67.8 | 67.8 | 68.0 |
| Total[3] | do. | 312.2 | 317.9 | 325.5 |
| Personal income: | | | | |
| Total | millions | $8,789 | $9,322 | $10,099 |
| Per capita | | $8,966 | $9,444 | $10,092 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 36.7 | 37.4 | 37.6 |
| Mining | | 39.6 | 41.5 | 41.1 |
| Total average hourly earnings, production workers | | $8.62 | $8.49 | $9.34 |
| Mining | | $13.04 | $13.35 | $14.31 |
| Earnings by industry: | | | | |
| Farm income | millions | $417 | $492 | $512 |
| Nonfarm | do. | $5,562 | $5,976 | $6,491 |
| Mining total[1] | do. | $99 | $117 | $129 |
| Metal mining | do. | $69 | $85 | $95 |
| Nonmetallic minerals except fuels | do. | $24 | $29 | $32 |
| Oil and gas extraction | do. | $5 | $3 | $2 |
| Manufacturing total | do. | $1,020 | $1,128 | $1,278 |
| Primary metal industries | do. | $11 | $3 | $4 |
| Stone, clay, and glass products | do. | $18 | 20 | $21 |
| Chemicals and allied products | do. | $64 | $65 | $115 |
| Construction | do. | $410 | $419 | $473 |
| Transportation and public utilities | do. | $498 | $520 | $536 |
| Wholesale and retail trade | do. | $1,012 | $1,071 | $1,164 |
| Finance, insurance, real estate | do. | $262 | $300 | $328 |
| Services | do. | $1,095 | $1,178 | $1,263 |
| Government and government enterprises | do. | $1,118 | $1,188 | $1,261 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 2,536 | 4,225 | 4,009 |
| Value of nonresidential construction | millions | $176.9 | $175.7 | $191.0 |
| Value of State road contract awards | do. | $53.0 | $80.2 | $87.4 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 242 | 269 | 277 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $303.3 | $415.2 | $412.3 |
| Value per capita | | $301 | $421 | $412 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

The J. R. Simplot Co.'s new Smoky Canyon phosphate operation in Caribou County came on-stream in the third quarter of 1984. The $40 million project includes a nearly 2-million-ton-per-year open pit mine, a milling and pumping complex, and a 27-mile-long slurry pipeline to the railhead at Conda.

The Coeur d'Alene mining district in Shoshone County celebrated 100 years of lode mining in 1984. Cumulative production for the 100-year period, from 30 major mines and an equal number of minor ones, totaled about 998.2 million troy ounces of silver, 507,000 troy ounces of gold, 8.4 million tons of lead, 3.2 million tons of zinc, and 169,800 tons of copper. The total value of all ore mined in the Coeur d'Alene District for the 100-year period is estimated at $4.6 billion.

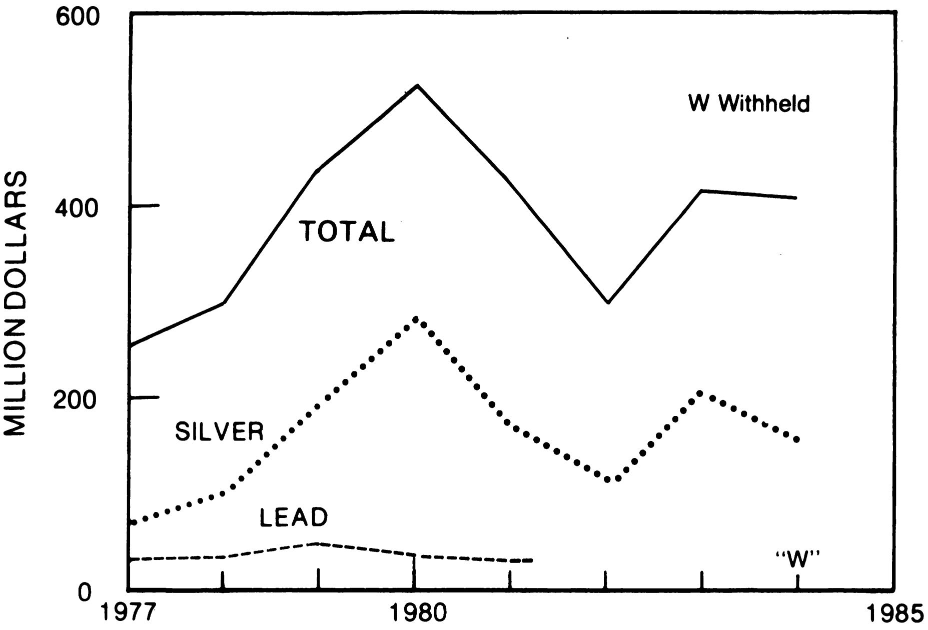

Figure 1.—Value of silver and total value of nonfuel mineral production in Idaho.

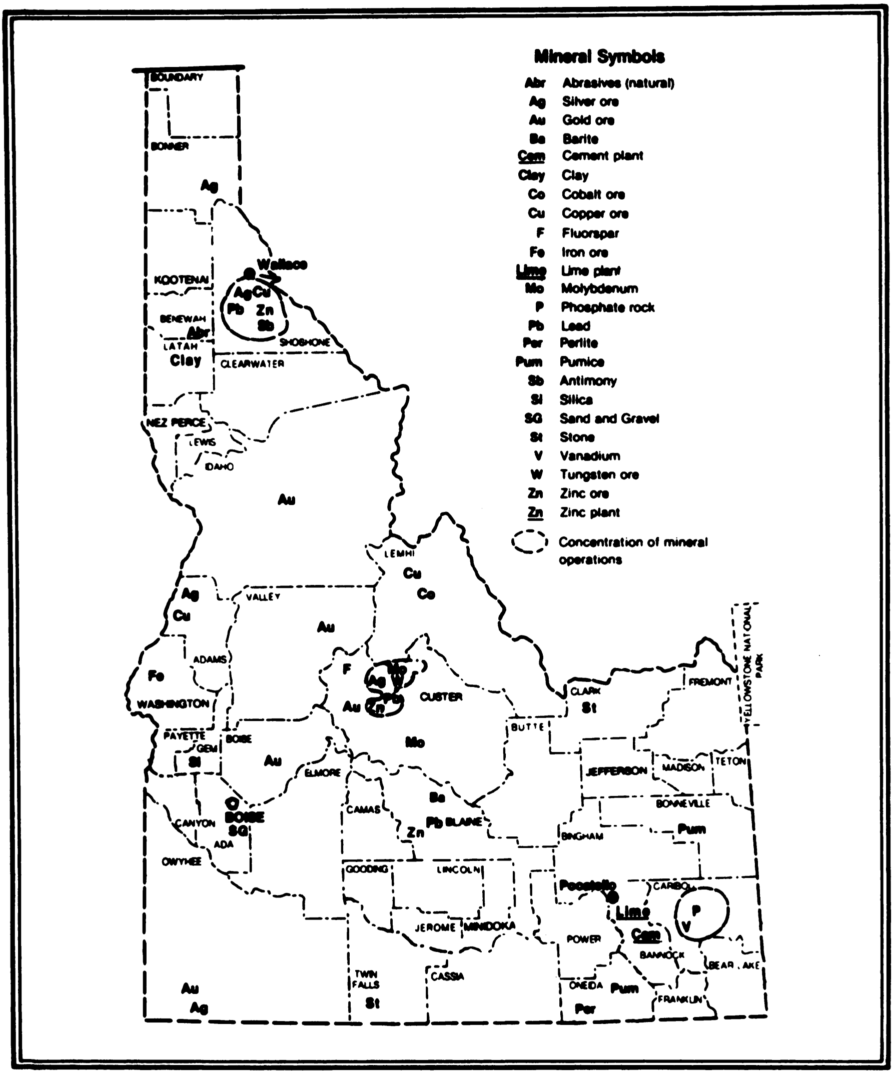

Figure 2.—Principal mineral producing localities in Idaho.

**Trends and Developments.**—Although silver prices decreased substantially from 1983 levels, all of the State's major silver mines maintained full-scale production during the year, and exploration and mine development continued at high levels. Factors bearing on decreased silver prices were strength of the U.S. dollar, high interest rates, a declining domestic inflation rate, and lower world oil prices. In 1984, Idaho mines produced more than 42% of the Nation's new silver, compared with 41% in 1983.

A limited recovery in the Idaho phosphate industry that started in 1983 continued into 1984. One phosphate mine that was closed in 1982 was reactivated, a new major mine went into production, and a major expansion and modernization of a phosphate fertilizer plant was started in 1984. Although phosphate prices remained low throughout the year, all companies produced at near capacity.

The Bunker Ltd. Partnership continued to maintain the Bunker Hill lead-zinc smelting and mining complex on a standby basis throughout the year, despite maintenance costs of $450,000 per month. Obstacles cited by Bunker Ltd. to an eventual reopening were the cost of compliance with Federal lead emission standards, a shortage of zinc concentrate, a continued soft price for lead, and a decline in lead markets.

**Exploration.**—Silver exploration activity in the Coeur d'Alene region remained generally high during 1984, but falling silver prices as the year progressed reduced the amount of exploration to less than the 1983 level.

Coeur Explorations Inc., the exploration subsidiary of Coeur d'Alene Mines Corp., continued work on property held by Royal Apex Silver Inc., Capitol Silver Mines Inc., and the Highland Aurora Mining Co. Drilling totaled 4,921 feet on the Royal Apex claims; five drill holes intersected veins containing silver sulfides, and one hole intersected a 17-foot-wide vein containing significant silver.

Hecla Mining Co. completed more than 2,900 feet of drifting and in excess of 4,800 feet of diamond drilling on the Boulder Creek vein system at the Atlas Mine, south of the Lucky Friday Mine. The work was being done under a $1.3 million exploration agreement signed in 1982 with Atlas Mining Co.

Sunshine Mining Co. continued diamond drilling on the Gold Creek Mining Co. property near Mullan, hoping to intersect an extension of the vein discovered by Bueno Coeur d'Alene Mining Co. The property has been under an exploration agreement to Sunshine Mining for 3 years. A deep hole to intersect the vein was down 2,700 feet in November 1984.

The Anaconda Minerals Co. continued exploration of a 25,000-acre land package acquired in 1982 from Bear Creek Mining Co. The area, owned by several small mining companies, is in the eastern end of the Coeur d'Alene District between the Placer Creek and Osburn Faults, and extends from south of the Caladay property eastward into Montana. As part of this project, Anaconda drilled a deep hole on Shoshone Silver Mining Co.'s claims near Stevens Peak on the Idaho-Montana border; the hole, projected for a 5,000-foot depth, was down more than 4,000 feet by December 1984. Anaconda also drilled a 3,275-foot-deep hole underground at the Reindeer Queen Mine. The Anaconda drilling projects will be among the deepest holes ever drilled in the district; a new drilling technology is being used that allows the drill to be guided to its target.

Noranda Exploration Inc. completed its exploration program on an Idaho-Montana Silver Inc. property straddling the Idaho-Montana border. Noranda did not find a deposit large enough for its requirements, so it terminated the lease.

Cominco American Incorporated continued with its second year of exploration for gold on the 109-claim Viking Resources property near Murray.

Pacific Coast Mines, a subsidiary of United States Borax & Chemical Corp., drilled two holes on Empire Gold Mines Inc.'s property near Murray.

Intermountain Minerals Engineers Inc. continued exploration at the Golden Dream property, 5 miles northwest of Murray. A drilling program was under way to block out gold ore reserves for production.

Mines Management Inc. leased the 6,100-acre Janstan property on the Idaho-Montana border. Geologic studies in 1983 discovered stratiform copper-silver mineralization; diamond drilling to better define the target area was planned for 1984.

Elsewhere in the State, Exxon Minerals Co. spent more than $1 million in land acquisition in the Hailey-Bellevue area of Blaine County. The company was believed to be exploring for stratiform base and precious metals; during 1984, Exxon opened old mines for geologic information, did some drilling, and continued an extensive surface exploration program.

Other companies active in the Hailey area included Getty Oil Co., which drilled at the Triumph Mine, and Billiton Exploration U.S.A. Inc. (a subsidiary of Royal Dutch/Shell), who explored in the Phi Kappa formation east of Sun Valley. BMEX Corp. had a small exploration crew working at the Anna Mine in Scorpion Gulch.

Preliminary exploration by Big Turtle Mines Inc. at its Treasure Vault Mine near Hailey indicated four base and precious metals vein systems.

Exploration efforts for silver and gold were continued by the Iron Mask Mining Co. and the Silver Butte Mining Co. in the

Talache District, Bonner County.

Tenneco Minerals Co. drilled several percussion holes at the Red Mountain gold prospect on Hyndman Ridge, north of Stanley in Custer County. Tenneco also drilled a gold property near the Rabbit's Foot Mine in Lemhi County, and put down several holes at the Mizpah Mine in Latah County.

Award Resources U.S.A. Inc. drilled 6 holes at 2 sites at the War Eagle Mine near Dixie, and Centennial Minerals Ltd. drilled 10 holes at the Orogrande-Frisco pit near Orogrande, Idaho County.

Noranda and Cominco explored for stratabound deposits in the Idaho Panhandle, east of the Purcell Trench, and Kennecott continued work on a 3-year gold exploration program on West Camas Creek in Clark County.

Anglo-Bomarc Mines Ltd. drilled several holes at the Hercules silver property near Cambridge in Washington County. The proposed open pit mine is currently on hold awaiting permitting and further planning.

**Employment.**—Sustained production levels in the silver industry (despite a decline in silver prices during the year), a general state of stability in other phases of metal mining, and a steady demand for phosphate fertilizers contributed to a slight increase in Idaho's mineral sector employment over the year. Metal mining employment advanced to 2,700 workers in 1984, an increase of about 4% over the 1983 figure, while overall mining employment declined slightly to 4,100 workers.

Average weekly earnings in 1984 for Idaho's mineral industry production workers was $588.14 for a workweek averaging 41.1 hours. Although mining industry wages remained the highest for any production workers group in the State, average weekly earnings were down $34.12 per week from those in 1983.

Yearly wages for mineral industry production workers in Shoshone County (largely representing the Coeur d'Alene region) averaged $33,676.99 in 1984, compared with an average wage of $32,712.59 for 1983.

**Legislation and Government Programs.**—The 47th Idaho Legislature, second regular session, passed legislation revising the State's Dredge and Placer Mining Statute. The revised law requires settling ponds if water used is to be returned to a natural water course, gives the land board the right to set the amount of reclamation bonds, calls for periodic inspection of placer and/or dredge operations, establishes a dredge and placer mining account for reclamation purposes, and empowers the land board to bring civil actions and levy fines against violators.

This legislature also passed legislation establishing the Idaho Geological Survey (IGS) (formerly the Idaho Bureau of Mines and Geology). The new law removed the IGS from the Department of Lands and established it as a special program of the University of Idaho. The director of the IGS was officially named the State Geologist.

A proposed wilderness bill, sponsored by Idaho's congressional delegation, that called for 526,000 acres of new wilderness for the State died in Congress. Wilderness advocates who wanted up to 3.4 million acres of new wilderness for Idaho were unwilling to settle on the Idaho delegation's compromise offer of 670,000 acres of new wilderness, 225,000 acres of wilderness study areas, and 700,000 acres of special planning areas.

The State of Idaho received nearly $4 million in U.S. Bureau of Land Management payments as receipts from the Mineral Leasing Act in 1984.

The IGS worked on several projects in cooperation with the U.S. Geological Survey (USGS), based on the Challis 2° sheet, completed in 1983 under the Conterminous United States Mineral Appraisal Program (CUSMAP). Field work centered on the Featherville area in the central part of the Atlanta lobe of the Idaho Batholith as an extension of the CUSMAP effort. The IGS sponsored the Borah Peak Red Book Conference with the USGS. The conference studied in detail the October 28, 1984, 7.3 magnitude earthquake in the Big Lost River Valley of east-central Idaho. A study of geologic hazards in the Preston 2° map area was completed under contract with the USGS.

Progress on preparation of a 1:100,000-scale surficial geologic map of the State was made in 1984 by the IGS. Mapping projects on glacial deposits in the Panhandle and on surficial deposits near Boise continued as part of this program. Major mapping programs in volcanic terranes were under way in Owyhee County and in west-central Idaho. During 1984, 11 new publications were released, including the "Cenozoic Geology of Idaho," which at 725 pages is the largest single publishing project ever undertaken by the IGS.

The Mining and Mineral Resources Institute of the University of Idaho received an allotment of $150,000 from the U.S. Bureau of Mines and further research grants totaling $258,000 in 1984. Idaho assisted the University of Nevada in work on a Mineral Industry Waste Treatment and Recovery Center that performed research in the treatment of mineral waste for the recovery of critical minerals and metals. The Idaho institute was also affiliated with the Virginia Polytechnic Institute in work on the Mine Systems Design and Ground Control generic areas.

The Idaho National Engineering Laboratory was funded at $2.7 million by the U.S. Bureau of Mines to conduct a multiyear extractive metallurgy and materials technology research and development program in strategic and critical minerals. The 1984 effort addressed (1) biologically assisted minerals processing, (2) metal gas reactions and thermal plastics, (3) joining silicon nitride-based ceramics, (4) joining rapidly solidified alloys, (5) nondestructive testing of ceramic and rapidly solidified alloy joints and materials, and (6) dehydration of aluminum chlorate hexahydrate.

### Table 4.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

| County | Mines producing[1] |  | Material sold or treated[2] (metric tons) | Gold |  | Silver |  |
|---|---|---|---|---|---|---|---|
|  | Lode | Placer |  | Troy ounces | Value | Troy ounces | Value |
| 1982, total | 21 | 2 | 1,582,057 | W | W | 14,830,351 | $117,901,293 |
| 1983, total | 24 | 2 | 2,104,344 | W | W | 17,684,278 | 202,308,141 |
| 1984: |  |  |  |  |  |  |  |
| Camas | 1 | -- | 12 | 32 | $11,541 | 1,282 | 10,436 |
| Custer | 3 | -- | W | 175 | 53,115 | W | W |
| Idaho | 1 | 1 | W | W | W | W | W |
| Owyhee | 1 | -- | W | W | W | W | W |
| Shoshone | 6 | 1 | W | W | W | W | W |
| Valley | 1 | -- | W | W | W | W | W |
| Total | 13 | 2 | 1,786,980 | W | W | 18,869,186 | 153,607,626 |

| County | Copper |  | Lead |  | Zinc |  | Total value |
|---|---|---|---|---|---|---|---|
|  | Metric tons | Value | Metric tons | Value | Metric tons | Value |  |
| 1982, total | 3,074 | $4,932,940 | W | W | W | W | $155,067,979 |
| 1983, total | 3,556 | 5,999,880 | [r]25,893 | [r]$12,375,857 | W | W | 247,678,621 |
| 1984: |  |  |  |  |  |  |  |
| Camas | -- | -- | -- | -- | -- | -- | 21,977 |
| Custer | W | W | W | W | -- | -- | W |
| Idaho | W | W | W | W | -- | -- | W |
| Owyhee | -- | -- | -- | -- | -- | -- | W |
| Shoshone | W | W | W | W | W | W | W |
| Valley | -- | -- | -- | -- | -- | -- | W |
| Total | [3]3,701 | [3]5,454,689 | W | W | W | W | [3]192,338,256 |

[r]Revised. W Withheld to avoid disclosing company proprietary data.

[1] Operations from which gold and silver are recovered as byproducts from sand and gravel operations and as byproducts of molybdenum are not counted as producing mines.

[2] Does not include gravel washed.

[3] Includes items indicated by symbol W; therefore, data do not add to total shown.

### Table 5.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by class of ore or other source material

| Source | Number of mines[1] | Material sold or treated[2] (metric tons) | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|---|---|
| Lode ore: | | | | | | | |
| Dry gold[3] | 3 | W | W | W | W | W | -- |
| Gold-silver | 2 | W | W | W | -- | -- | -- |
| Silver | 7 | 667,000 | W | 17,099,485 | W | W | W |
| Total | 12 | W | W | W | W | W | W |
| Lead | 1 | W | W | W | W | W | -- |
| Other lode material: | | | | | | | |
| Molybdenum | -- | -- | W | W | -- | -- | -- |
| Total lode | 13 | [4]1,786,980 | W | [4]18,869,186 | [4]3,701 | W | W |
| Placer | 2 | -- | W | -- | -- | -- | -- |
| Grand total | 15 | 1,786,980 | W | 18,869,186 | 3,701 | W | W |

W Withheld to avoid disclosing company proprietary data.

[1] An operation from which gold and silver were recovered as byproducts from molybdenum ore is not counted as a producing mine.

[2] Does not include gravel washed.

[3] Includes material that was leached.

[4] Includes items indicated by symbol W; therefore, data do not add to total shown.

### Table 6.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by type of material processed and method of recovery

| Type of material processed and method of recovery | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|
| Lode ore: | | | | | |
| Cyanidation | W | W | -- | -- | -- |
| Smelting of concentrates | W | 17,145,181 | 3,701 | W | W |
| Direct smelting of ore | W | W | -- | -- | -- |
| Total | W | [1]18,869,186 | 3,701 | W | W |
| Placer | W | -- | -- | -- | -- |
| Grand total | W | 18,869,186 | 3,701 | W | W |

W Withheld to avoid disclosing company proprietary data.

[1] Includes items indicated by symbol W; therefore, data do not add to total shown.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

**Antimony.**—Idaho was the only State in the Nation reporting antimony production in 1984. Production for the year was down slightly from that reported in 1983. The Nation's only antimony producer, Sunshine Mining, recovered antimony as a byproduct from the treatment of tetrahedrite, the principal silver-bearing ore mineral at the Sunshine Mine. Concentrates containing 557 short tons of antimony were produced in 1984, compared with 585 tons in 1983.

Exploration was carried out by American Independence Mines at the Antimony Rainbow Mine in Valley County.

**Copper.**—Copper production, reported from nine mines in 1984, was up 4% in quantity but was down 9% in value from that achieved in 1983. More than 3,700 metric tons was produced at a value of nearly $5.5 million, ranking Idaho eighth nationally in 1984 copper output. The largest producers, all from the Coeur d'Alene District, Shoshone County, were the Galena, Coeur, Sunshine, Lucky Friday, and Crescent Mines. More than 99% of total State production came from six Coeur d'Alene District mines, where copper was a byproduct of silver recovery. An additional small production was reported from Custer County.

**Gold.**—Idaho gold production decreased 27% in quantity and 38% in value from that of 1983, reflecting decreased gold prices in 1984. The State dropped in national ranking to ninth for the amount and value of gold produced in 1984. Production was reported from 13 lode mines in 1984, contrasted to 26 mines reporting production in 1983. For the second consecutive year, the West End Mine of Superior Mining Co. in Valley County was the State's largest producer, with NERCO Minerals Co.'s DeLamar Mine in Owyhee County ranking second.

Production at Superior Mining's West End Mine was down from the 1983 level. The company announced in November that the mine may close in 2-1/2 years, 5 years earlier than expected, owing to low gold prices and a consequent decrease in reserves.

Coeur d'Alene Mines Corp. completed a feasibility study for its proposed $6.7 million, 450,000-ton-per-year Sunnyside open pit gold mine and heap leach facility at Thunder Mountain in Valley County. Detailed exploration and about 95% of site preparation work were accomplished in 1984; initial production was slated for spring 1986.

Geodome Resources Ltd. accomplished detailed exploration work and mine planning at its proposed 2,000-ton-per-day open pit Sunbeam Mine northeast of Stanley, in Custer County. The company expected to be in production in late 1985.

U.S. Antimony Corp. processed tailings from various mines in the Yankee Fork District, Custer County, explored at the Rob Roy Mine, and operated its 250-ton-per-day mill and leach plant at Preacher's Cove.

Golden Maple Mining and Leaching Co. submitted a revised proposal for a gold mining and cyanide heap-leaching operation at the Valley Creek Mine near Stanley, Custer County.

Ager, Berretta, and Ellis, an exploration group with Nugold Enterprises Corp., carried out a development program at the Ericson Reef gold property north of Elk City, Idaho County. The company hopes to establish an open pit, vat leach operation in 1985 and will drill 50 additional holes to better define the ore body.

The Yanke Machine Co. continued development of a narrow, high-grade gold vein at the Talache Mine at Atlanta in Elmore County.

Placer gold production was reported by two companies from Shoshone and Idaho Counties; total production was slightly more than five times that reported for 1983. The number of stream alteration permits issued in 1984 by the Idaho Department of Water Resources for hobby-type suction dredges was 470, down considerably from the 606 permits issued in 1983.

**Lead.**—Idaho retained its second ranking in lead production for 1984, although the quantity produced was only a small fraction of the production in Missouri, the major producing State. Although six mines reported lead production for 1984, nearly all came from the Lucky Friday Mine in Shoshone County.

U.S. Antimony leased the Red Bird silver-lead mine in Custer County and worked on sinking a 250-foot shaft below the 900 level; production was planned at 15 to 20 tons per day.

**Molybdenum.**—The quantity of first year molybdenum production at Amoco Minerals Co.'s Cyprus Thompson Creek Mine near Clayton, in Custer County, was sufficient to rank Idaho third in the Nation. The mine operated three shifts per day, 7 days per week in preproduction stripping and mining for most of 1984; the mill operated on a 24-hour-per-day schedule. Total employment for the operation in October was 495.

Throughout the year, an experimental cyanide leach system was tested to extract low-grade precious metals present in the ore, and a small gold-silver production was achieved from this circuit.

**Silver.**—Idaho remained the top domestic silver producing State, accounting for more than 42% of total 1984 production. Although silver prices declined sharply during the year, the State's production increased nearly 7% over that of 1983. Five mines in the Coeur d'Alene District accounted for almost 90% of the total output reported from 14 mines in the State.

In its 100th year of operation, Sunshine Mining's Sunshine Mine regained first ranking in silver production in the Nation. Since its discovery in 1884, the mine has yielded more than 300 million troy ounces of silver, plus significant tonnages of copper and antimony. Except for 1972, the year of a disastrous mine fire, and the rehabilitation year of 1973, the Sunshine Mine has been among the top domestic producers for the past 50 years. Development work in 1984 was concentrated in the No. 12 shaft area. The 4600 and 4400 level stations were completed, and an ore transfer system established between the 4200 and 5000 levels. Work continued on development of the Copper and Syndicate Veins and in the Rambo area. A rebuilding of the mine ventilating system increased fresh air flow by 25%, and mining costs were decreased by 6% owing to improved mining techniques and better labor relations.

Sunshine Mining's $18 million hydrometallurgical silver refinery on Big Creek, near Kellogg, was completed during the year, and the first silver bar from concentrates processed at the refinery was poured on December 29. The refinery has full design capacity of 8 million ounces per year; concentrates from the Sunshine Mine and from Sunshine Mining's 16-to-1 Mine in Nevada will be refined at the Big Creek plant. On October 24, Sunshine Mining officially opened its new operational headquarters in Boise.

Production at Hecla's Lucky Friday Mine was down slightly from the record high level of 1983; the mine ranked second in the Nation for silver production in 1984. A new 3-year labor contract was ratified in early April with the United Steelworkers of America (USWA), representing miners at the Lucky Friday Mine. Hecla merged with Ranchers Exploration and Development Corp. in late July.

Hecla continued work on the $17 million Consolidated Silver joint venture project at the Silver Summit Mine near Osburn. A lower extension of the Silver Summit No. 4 vein was intersected in August; assays on the vein ran 19 ounces of silver per ton for 70 feet over a 4.5-foot mining width, and 34 ounces per ton for 50 feet over a 4-foot width. A 943-foot drift following the structure was completed at yearend, and evaluation of the vein was to continue in 1985. Hecla is the operator and majority owner of the venture, along with Sunshine Mining and Coeur d'Alene Mines.

Hecla began a 3-year underground exploration program on property owned by Allied Silver-Lead Co., immediately west of Hecla's Lucky Friday Mine at Mullan. By yearend, a crosscut had been driven 1,020 feet southwest from Hecla's Silver Shaft, and two diamond drill holes were drilled southerly. No significant mineralization was found, but primary targets will not be reached until 1986.

Hecla and Bunker Ltd.'s jointly owned Star Mine was back in limited production at yearend. James Striker, who operated a lease above the 1700 level of the mine from 1961 until it closed in 1982, signed a lease on the mine and mill in August and started rehabilitating the property. His company, the Star-Morning Mining Co., will employ about 30 people.

ASARCO Incorporated's Galena Mine again was the fourth ranked domestic silver producer, with Asarco's Coeur Mine ranking sixth. In the Galena Mine, the No. 3 shaft was deepened 166 feet to 5,467 feet, and the 5200 level station was enlarged and drifts started east and west on that level. The 750-ton-per-day mill was renovated, and the speed control and braking mechanism on the main hoist were rebuilt to enable deeper mining.

In January, Asarco signed a new 3-year labor agreement with the USWA, the union that represents 300 Asarco employees in the Galena Mine and Star-Morning shops.

Asarco continued exploration at the American Silver project, where American Silver ground is being investigated west from the 4300 level of the Coeur Mine. By yearend, 4,413 feet of crosscutting and drifting had been completed, and about $1.8 million of the $3.5 million budgeted for the project had been expended. Partners in the venture, which was started in mid-1980, include Coeur d'Alene Mines, Callahan Mining Corp., and Hecla.

Production at Bunker Ltd.'s Crescent silver mine, which reopened in November 1983, continued throughout the year. Ores were beneficiated in the Crescent circuit at the Bunker Hill mill, and concentrates were shipped by rail and ship to Brussels, Belgium, where they were processed by Société Générale des Mines (SGM). Development plans at the Crescent Mine include sinking the No. 2 shaft an additional 800 feet, developing two mining levels, and more than 4,500 feet of crosscutting and drifting. Drilling stations will be cut at the 4500, 4700, and 4900 levels on the No. 2 shaft, and drilling will be done in an effort to find the favorable host rocks of the Syndicate Vein. The development work will require a capital expenditure of between $7.5 and $8 million in the next 3 years.

The projected 5,100-foot-deep shaft at Callahan Mining's Caladay project was just short of 5,000 feet at yearend. Shaft and pump stations were installed on the 4600 and 4900 levels, a loading pocket was started on the 4900 level, and a diamond drill hole from the 4900 level penetrated the Polaris Fault. The company spent $3.7 million on the Caladay in 1984, for a cumulative total of $20.8 million.

Ore shipments commenced again in midyear from the lease at the Canyon Silver Mine on Canyon Creek. The mine, closed in

1973, was being worked by a group of lessees that started in late 1982. Canyon Silver ore is being milled at Intermountain Minerals Engineers' custom mill at the Nabob Mine on Pine Creek; concentrates are shipped to the Cominco smelter at Trail, British Columbia, Canada.

The DeLamar silver mine in Owyhee County changed hands in September, when NERCO, a subsidiary of Pacific Corp., purchased MAPCO Mineral Corp.'s controlling 52.5% share for $22.3 million. In August, mining was started from the Glen silver pit adjacent to the DeLamar property. The DeLamar Mine produced about 2,100 tons of open pit ore per day and was Idaho's largest silver producer not in the Coeur d'Alene District. The mine ranked fifth in silver production for the State in 1984.

The Clayton Silver Mine in Custer County returned to production in early February, ending a suspension of operations since the Challis earthquake of October 28, 1983, which caused a massive inflow of water that flooded the lower levels in the mine. A new pumping system with increased capacity was installed, and the mine was back to its 260-ton-per-day capacity.

**Vanadium.**—Idaho ranked second in the Nation in vanadium production, accounting for more than one-third of total production in 1984. Reflecting the modest national recovery in the vanadium market from the depressed level of 1983, the State's vanadium production increased 35% in quantity and 45% in value over that of 1983. Idaho was the only State to recover vanadium from ferrophosphorus; ferrophosphorus slag from Idaho phosphate was processed for vanadium pentoxide by Kerr-McGee Chemical Corp. at Soda Springs in Caribou County.

**Zinc.**—Zinc production in the State, although minimal compared with pre-1983 years, increased 45% in quantity and 70% in value over production recorded in 1983. One mine in the Coeur d'Alene District reported zinc production in 1984.

## NONMETALS

**Cement.**—Idaho's portland cement production was up for 1984 owing to increased building and construction resulting from a continuing improvement in the U.S. economy. Portland cement production increased 18% in quantity and nearly 28% in value over that recorded in 1983. A small amount of masonry cement was also produced. Ash Grove Cement West Inc., at Inkom in Bannock County, was the State's only cement producer.

**Clays.**—Idaho's 1984 clay production increased almost 5 times in quantity and more than 2-1/2 times in value over that reported in 1983. Fire clay, kaolin, and bentonite were mined, in order of decreasing importance, from three pits in Latah and Clark Counties. The State's largest volume clay producer was A. P. Green Refractories Co. in Latah County.

**Garnet.**—Garnet production at the Emerald Creek Garnet Milling Co. operation, Fernwood, Benewah County, was slightly higher than that for 1983. The company produced garnet sands from the State's largest placer operation, on Emerald and Carpenter Creeks. The company was the Nation's largest producer of garnet for abrasives and as a filtering medium.

**Gem Stones.**—Fire opals, jasper, and star garnets contributed to the estimated $150,000 value in gem stones recovered and sold in the State in 1984. Spencer Opal Mines in Clark County completed patent applications for its claims; it mined opal and allowed "rock hounds" to dig opal for a fee in 1984.

**Gypsum.**—All of Idaho's gypsum production came from the Consumers Coop Association Inc.'s Iron Mountain Mine in Washington County. The output increased by 75%, but the value decreased by 38% from that reported for 1983.

**Lime.**—Amalgamated Sugar Co.'s three lime plants in Canyon, Minidoka, and Twin Falls Counties accounted for all of the State's 1984 lime production. Total reported 1984 output was nearly the same as that in 1983, but value declined by 27%.

**Perlite.**—Oneida Perlite Corp. mined and processed perlite at its Malad City operation in Oneida County. The expanded perlite was used as a fireproofing material, in lightweight aggregate, and as a filtering medium. Reported production was down from the 1983 level, but unit value for the product rose slightly in 1984.

**Phosphate Rock.**—Idaho ranked third in the Nation in production of marketable phosphate rock, accounting for nearly 10% of the total domestic output in 1984. Production levels were nearly the same, but higher product prices brought the total value up nearly 6% over that of 1983. The primary products processed from Idaho phosphate were elemental phosphorus and phosphoric acid used in fertilizer manufacture.

Seven open pit phosphate mines in the southeastern Idaho phosphate field in Bingham and Caribou Counties produced during the year. Simplot, the largest phosphate producer in the State, closed down the depleted Conda Mine near midyear and brought its new $40 million Smoky Canyon

Mine and 27-mile slurry pipeline on-stream. Simplot also operated the Gay Mine on the Fort Hall Indian Reservation. Simplot started work in 1984 on a $50 million expansion and modernization program at its Pocatello phosphoric acid manufacturing complex.

In May, Stauffer Chemical Co. reopened its Wooley Valley Mine that had been shut down in April 1982 due to adverse market conditions. Phosphate ore was shipped to the company's elemental phosphorus plant at Silver Bow, MT. Additional production was reported by Monsanto Co., Conda Partnership, and Alumet. The FMC Corp. operated its elemental phosphorus plant at Pocatello.

**Pumice.**—Conforming to a national trend toward increased production, pumice mined in Idaho in 1984 increased nearly 29% in quantity and 36% in value over that of 1983.

Two operations in Bonneville County and one in Oneida County accounted for the State's production. The largest pumice producer was Amcor Inc. from its Fan Creek claims near Idaho Falls; the product was used as lightweight concrete aggregate. Producers Pumice mined pumice from the Rock Hollow Mine near Ammon; the material was used in lightweight concrete block manufacture and as lightweight aggregate. Hess Pumice Products operated the Wrights Creek Mine near Malad; the product was used in lightweight building blocks, as an abrasive in soaps and cleansers, and as a filtering agent.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on estimates made before yearend.

The 1984 output of construction sand and gravel in the State doubled in quantity and value, and the unit value increased slightly over that reported for 1982, when the last complete canvass was taken. Large increases in the asphaltic concrete and road base and coverings production categories reflect increased road building and repair throughout the State during 1984. Construction sand and gravel production was reported from 69 operations in 26 Idaho counties. Ada, Kootenai, Bonneville, and Canyon Counties accounted for nearly 46% of the total production reported.

**Table 7.—Idaho: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 991 | $3,599 | $3.63 |
| Plaster and gunite sands | 28 | 152 | 5.44 |
| Concrete products | W | W | 3.00 |
| Asphaltic concrete | 478 | 1,597 | 3.34 |
| Road base and coverings | 2,157 | 5,180 | 2.40 |
| Fill | 236 | 510 | 2.16 |
| Snow and ice control | W | W | 3.88 |
| Other[1] | 834 | 2,470 | 2.96 |
| Total[2] or average | 4,725 | 13,509 | 2.86 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes roofing granules, other unspecified uses, and uses indicated by symbol W.

[2] Data do not add to totals shown because of independent rounding.

*Industrial.*—Unimin Corp. produced industrial sand and gravel at its operation in Emmett, Gem County. Industrial sand uses were in glass containers, for sandblasting sand, filtration-medium sand, in fiberglass manufacture, for roofing granules, and for other applications.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

The Marble Shop Inc. at Idaho Falls in Bonneville County had a slowdown in sales of travertine. The strong U.S. dollar favored Italian travertine that was imported for less than mining and shipping costs in Idaho. The company continued research on the potential of using its chemically pure travertine for industrial lime.

Idaho Quartzite Corp., at Oakley in Cassia County, mined quartzite for rubble building stone, and also marketed some quartzite for tile.

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[1] State Mineral Officer, Bureau of Mines, Spokane, WA.

[2] Associate director, Idaho Geological Survey, Moscow, ID.

[3] Director, Idaho Geological Survey, Moscow, ID.

## Table 8.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Antimony: | | | |
| Sunshine Mining Co.[1] | 815 Park Blvd.<br>Boise, ID 83702 | Mine, mill, plant | Shoshone. |
| Cement: | | | |
| Ash Grove Cement West Inc | 111 SE. Madison St.<br>Portland, OR 97214 | Surface mine and plant. | Bannock. |
| Clays: | | | |
| Clayburn Industries Ltd | 3202 Beta<br>Burnaby, BC, Canada | Surface mine | Latah. |
| A. P. Green Refractories, a subsidiary of United States Gypsum Co. | Box 158<br>Troy, ID 83871 | Surface mine and plant. | Do. |
| Copper: | | | |
| ASARCO Incorporated | Box 440<br>Wallace, ID 83873 | Mine and mill | Shoshone. |
| Hecla Mining Co | Box 320<br>Wallace, ID 83873 | do | Do. |
| Sunshine Mining Co.[1] | 815 Park Blvd.<br>Boise, ID 83702 | do | Do. |
| Gold: | | | |
| Hecla Mining Co | Box 320<br>Wallace, ID 83873 | do | Do. |
| NERCO Minerals Co | 3230 Airport Way<br>Fairbanks, AK 99701 | Surface mine and mill. | Owyhee. |
| Superior Mining Co | 7275 Franklin Rd.<br>Boise, ID 83709 | Surface mine and leach plant. | Valley. |
| Gypsum: | | | |
| Consumers Coop Association Inc | 265 East Commercial<br>Weiser, ID 83672 | Surface mine | Washington. |
| Lead: | | | |
| Hecla Mining Co | Box 320<br>Wallace, ID 83873 | Mine and mill | Shoshone. |
| Lime: | | | |
| Amalgamated Sugar Co | First Security Bank Bldg.<br>Ogden, UT 84402 | Plants | Various. |
| Perlite: | | | |
| Oneida Perlite Corp | Box 162<br>Malad City, ID 83252 | Surface mine and plant. | Oneida. |
| Phosphate rock: | | | |
| Conda Partnership | Box 37<br>Conda, ID 83230 | do | Caribou. |
| Monsanto Co | Box 816<br>Soda Springs, ID 83276 | Surface mine | Do. |
| J. R. Simplot Co | Box 912<br>Pocatello, ID 83201 | Surface mine and plant. | Bingham and Caribou. |
| Pumice: | | | |
| Amcor Inc | Box 1141<br>Idaho Falls, ID 83401 | Quarry and plant | Bonneville. |
| Hess Pumice Products | Box 209<br>Malad City, ID 83252 | do | Oneida. |
| Producers Pumice | 6001 Fairview Ave.<br>Boise, ID 83704 | Quarry | Bonneville. |
| Sand and gravel: | | | |
| Construction: | | | |
| Central Premix Concrete Co | Box 757<br>Coeur d'Alene, ID 83814 | Pit | Kootenai. |
| DeAtly Co., division of Eucon Corp | Box 648<br>Lewiston, ID 83501 | Pit | Nez Perce. |
| Kloeper S & G Transportation & Equipment Co. | Box 87<br>Paul, ID 83341 | Pits | Cassia and Minidoka. |
| Monroc Inc., RTP Concrete | Box 537<br>Salt Lake City, UT 84110 | do | Various. |
| Rock Contractors | Box 815<br>Meridian, ID 83642 | do | Ada. |
| Seubert Excavators | Box 57<br>Cottonwood, ID 83522 | do | Various. |
| Industrial: | | | |
| Unimin Corp | 258 Elm St.<br>New Canaan, CT 06840 | Pit | Gem. |
| Silver: | | | |
| ASARCO Incorporated | Box 440<br>Wallace, ID 83873 | Mine and mill | Shoshone. |
| Clayton Silver Mines[1] | Box 890<br>Wallace, ID 83873 | do | Custer. |
| Hecla Mining Co | Box 320<br>Wallace, ID 83873 | do | Shoshone. |
| NERCO Minerals Co | 3230 Airport Way<br>Fairbanks, AK 99701 | Surface mine and mill. | Owyhee. |
| Sunshine Mining Co.[1] | 815 Park Blvd.<br>Boise, ID 83702 | Mine and mill | Shoshone. |
| Stone (dimension): | | | |
| The Marble Shop Inc | 3935 N. Yellowstone Hwy.<br>Idaho Falls, ID 83401 | Quarry and plant | Bonneville. |
| Vanadium: | | | |
| Kerr-McGee Chemical Corp | Box 478<br>Soda Springs, ID 83276 | Plant | Caribou. |
| Zinc: | | | |
| Hecla Mining Co | Box 320<br>Wallace, ID 83873 | Mine and mill | Shoshone. |

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[1] Also lead.

# The Mineral Industry of Illinois

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey Division, Illinois Department of Energy and Natural Resources, for collecting information on all nonfuel minerals.**

### By James J. Hill[1] and Wanda J. West[2]

The value of nonfuel mineral production in Illinois was $471.9 million in 1984. For the second consecutive year, mineral production value increased, climbing about 16% over the 1983 figure. Nationally, the State ranked 18th in nonfuel mineral production value. Illinois led the Nation in output of fluorspar, industrial sand, and tripoli and in the manufacture of iron oxide pigments. The State ranked fourth in the production of peat and crushed stone. Production increased for all nonfuel mineral commodities except common clays and peat.

**Table 1.—Nonfuel mineral production in Illinois[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Cement (portland) ______ thousand short tons__ | 1,857 | $74,975 | 1,997 | $82,622 |
| Clays[2] ______ do____ | 717 | 3,360 | 253 | 940 |
| Gem stones ______ | NA | 15 | NA | 15 |
| Peat ______ thousand short tons__ | W | W | 49 | W |
| Sand and gravel: | | | | |
| Construction ______ do____ | $^{e}$21,100 | $^{e}$58,400 | 25,969 | 72,477 |
| Industrial ______ do____ | 4,060 | 42,871 | 4,100 | 52,197 |
| Stone: | | | | |
| Crushed ______ do____ | 42,761 | 166,860 | $^{e}$48,500 | $^{e}$191,600 |
| Dimension ______ do____ | 2 | 71 | -- | -- |
| Combined value of barite, cement (masonry), clays (fuller's earth), fluorspar, lead, lime, silver, tripoli, zinc, and values indicated by symbol W ______ | XX | 60,355 | XX | 72,010 |
| Total ______ | XX | 406,907 | XX | 471,861 |

$^{e}$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth; value included with "Combined value" figure.

### Table 2.—Value of nonfuel mineral production in Illinois, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adams | W | $14,503 | Stone (crushed). |
| Alexander | W | W | Tripoli. |
| Bond | W | 200 | Clays. |
| Boone | $267 | 385 | Stone (crushed). |
| Brown | (2) | -- | |
| Bureau | 475 | (3) | |
| Calhoun | (2) | 218 | Stone (crushed). |
| Carroll | (2) | 688 | Do. |
| Cass | (4) | W | Do. |
| Champaign | 1,422 | (3) | |
| Christian | (2) | W | Stone (crushed). |
| Clark | W | W | Do. |
| Clay | (2) | 1,033 | Do. |
| Clinton | W | (3) | |
| Coles | W | W | Stone (crushed). |
| Cook | 32,571 | W | Stone (crushed), lime, peat. |
| Cumberland | 248 | (3) | |
| De Kalb | 293 | W | Stone (crushed). |
| De Witt | 139 | (3) | |
| Douglas | (2) | W | Stone (crushed). |
| Du Page | W | 3,267 | Do. |
| Effingham | W | (3) | |
| Fayette | W | W | Stone (crushed). |
| Ford | W | (3) | |
| Fulton | W | (3) | |
| Gallatin | W | (3) | |
| Greene | (2) | 697 | Stone (crushed). |
| Grundy | W | (3) | |
| Hancock | W | 1,624 | Stone (crushed). |
| Hardin | W | W | Fluorspar, stone (crushed), zinc, barite, lead, silver. |
| Henderson | (2) | W | Stone (crushed). |
| Henry | W | 1,542 | Do. |
| Jackson | (2) | W | Do. |
| Jersey | (2) | 120 | Do. |
| Jo Daviess | 373 | 895 | Do. |
| Johnson | (2) | W | Do. |
| Kane | 13,551 | 2,908 | Stone (crushed), stone (dimension). |
| Kankakee | W | W | Stone (crushed), clays. |
| Kendall | W | W | Stone (crushed). |
| Lake | W | W | Peat. |
| La Salle | W | W | Sand (industrial), cement, stone (crushed), clays. |
| Lawrence | W | (3) | |
| Lee | W | 4,164 | Stone (crushed), cement. |
| Livingston | 1,476 | W | Stone (crushed), clays. |
| Logan | 833 | W | Stone (crushed). |
| McDonough | W | W | Stone (crushed), clays. |
| McHenry | 9,663 | (3) | |
| McLean | 2,441 | (3) | |
| Macon | W | (3) | |
| Madison | W | 3,131 | Stone (crushed). |
| Marshall | W | (3) | |
| Mason | W | (3) | |
| Massac | W | W | Cement. |
| Menard | (2) | W | Stone (crushed). |
| Mercer | (2) | 358 | Do. |
| Monroe | (2) | W | Do. |
| Montgomery | (2) | 2,604 | Do. |
| Moultrie | W | (3) | |
| Ogle | W | W | Sand (industrial), stone (crushed). |
| Peoria | 1,030 | 331 | Stone (crushed). |
| Piatt | 377 | (3) | |
| Pike | W | 2,509 | Stone (crushed). |
| Pulaski | W | W | Clays, stone (crushed). |
| Putnam | 41 | (3) | |
| Randolph | W | W | Stone (crushed). |
| Rock Island | W | 4,053 | Do. |
| St. Clair | W | 5,717 | Do. |
| Sangamon | 2,418 | (3) | |
| Schuyler | 245 | 140 | Stone (crushed). |
| Scott | (2) | W | Do. |
| Shelby | (2) | 112 | Do. |
| Stephenson | W | 956 | Do. |
| Tazewell | W | (3) | |
| Union | (2) | W | Stone (crushed). |
| Vermilion | 238 | W | Do. |
| Wabash | W | (3) | |
| Warren | (2) | W | Stone (crushed). |
| Washington | (2) | 450 | Do. |
| White | W | (3) | |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Illinois, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Whiteside | W | $3,279 | Peat, stone (crushed). |
| Will | $2,708 | 13,025 | Stone (crushed). |
| Winnebago | 345 | 971 | Do. |
| Woodford | 2,239 | (4) | |
| Undistributed[5] | 167,796 | 278,625 | |
| Sand and gravel (construction) | XX | [e]58,400 | |
| Stone: | | | |
| Crushed | [e]148,300 | XX | |
| Dimension | [r] [e]43 | XX | |
| Total[6] | [r]389,539 | 406,907 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Less than 1/2 unit.

[5] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[6] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Illinois business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 11,466 | 11,474 | 11,511 |
| Total civilian labor force | do | 5,597 | 5,594 | 5,604 |
| Unemployment | do | 634 | 640 | 511 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 27.1 | 24.6 | 24.9 |
| Nonmetallic minerals except fuels | do | 4.7 | 4.5 | 4.8 |
| Coal mining | do | 15.4 | 14.1 | 14.2 |
| Oil and gas extraction | do | 7.0 | 5.9 | 5.8 |
| Manufacturing total | do | 1,013.4 | 955.8 | 985.5 |
| Primary metal industries | do | 66.7 | 58.8 | 61.1 |
| Stone, clay, and glass products | do | 26.1 | 24.6 | 24.3 |
| Chemicals and allied products | do | 59.0 | 59.4 | 61.2 |
| Petroleum and coal products | do | 9.2 | 9.2 | 9.3 |
| Construction | do | 156.4 | 144.2 | 149.9 |
| Transportation and public utilities | do | 274.3 | 264.5 | 274.2 |
| Wholesale and retail trade | do | 1,087.7 | 1,097.5 | 1,144.4 |
| Finance, insurance, real estate | do | 326.0 | 320.1 | 317.8 |
| Services | do | 990.6 | 1,022.5 | 1,048.4 |
| Government and government enterprises | do | 717.9 | 701.6 | 691.3 |
| Total[1] | do | 4,593.3 | 4,530.6 | 4,636.5 |
| Personal income: | | | | |
| Total | millions | $137,419 | $142,194 | $158,876 |
| Per capita | | $11,985 | $12,393 | $13,802 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 40.6 | 40.6 |
| Mining | | 41.2 | 42.9 | 43.9 |
| Total average hourly earnings, production workers | | $9.31 | $9.70 | $10.06 |
| Mining | | $12.98 | $13.60 | $14.11 |
| Earnings by industry: | | | | |
| Farm income | millions | $1,307 | $-232 | $2,896 |
| Nonfarm | do | $95,769 | $100,305 | $110,740 |
| Mining total | do | $1,112 | $989 | $1,111 |
| Nonmetallic minerals except fuels | do | $144 | $144 | $155 |
| Coal mining | do | $682 | W | W |
| Oil and gas extraction | do | $286 | $220 | $257 |
| Manufacturing total | do | $25,896 | $25,570 | $28,444 |
| Primary metal industries | do | $1,972 | $1,767 | $2,073 |
| Stone, clay, and glass products | do | $668 | $667 | $727 |
| Chemicals and allied products | do | $1,780 | $1,831 | $2,009 |
| Petroleum and coal products | do | $417 | $425 | $450 |
| Construction | do | $4,551 | $4,685 | $5,415 |
| Transportation and public utilities | do | $7,843 | $8,199 | $9,023 |
| Wholesale and retail trade | do | $16,755 | $17,375 | $19,277 |
| Finance, insurance, real estate | do | $7,113 | $7,992 | $9,018 |
| Services | do | $18,770 | $21,117 | $23,176 |
| Government and government enterprises | do | $13,512 | $14,133 | $15,001 |

See footnotes at end of table.

Table 3.—Indicators of Illinois business activity —Continued

| | 1982r | 1983 | 1984p |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 18,980 | 30,230 | 29,456 |
| Value of nonresidential construction millions | $1,872.9 | $1,788.1 | $2,270.2 |
| Value of State road contract awards do | $510.0 | $782.0 | $1,052.5 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 2,363 | 2,305 | 2,686 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $389.5 | $406.9 | $471.9 |
| Value per capita | $34 | $35 | $41 |

pPreliminary. rRevised. W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, Highway and Heavy Construction Magazine, Illinois Department of Employment Security in cooperation with the Bureau of Labor Statistics, U.S. Department of Labor, and U.S. Bureau of Mines.

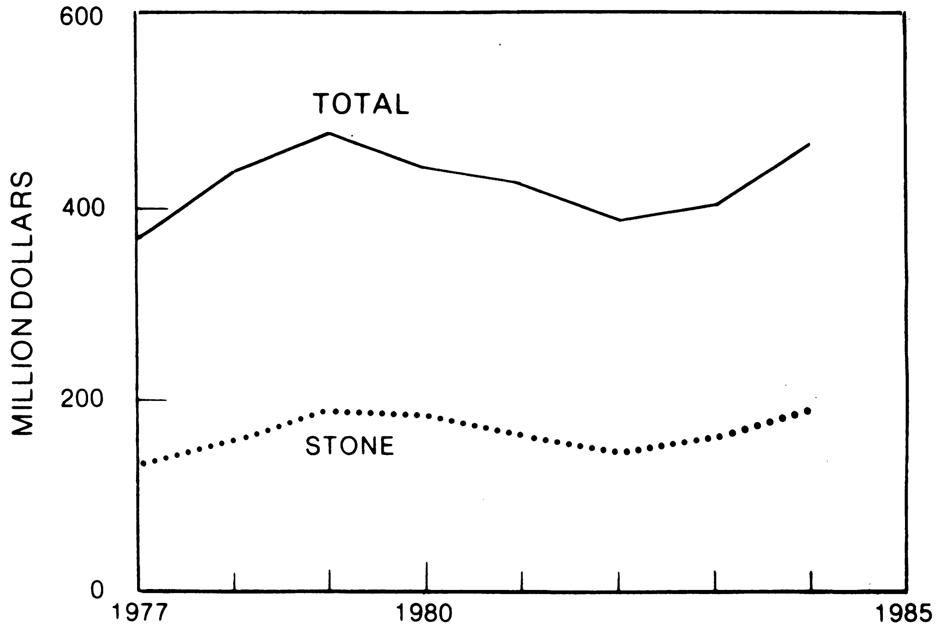

Figure 1.—Value of stone and total value of nonfuel mineral production in Illinois.

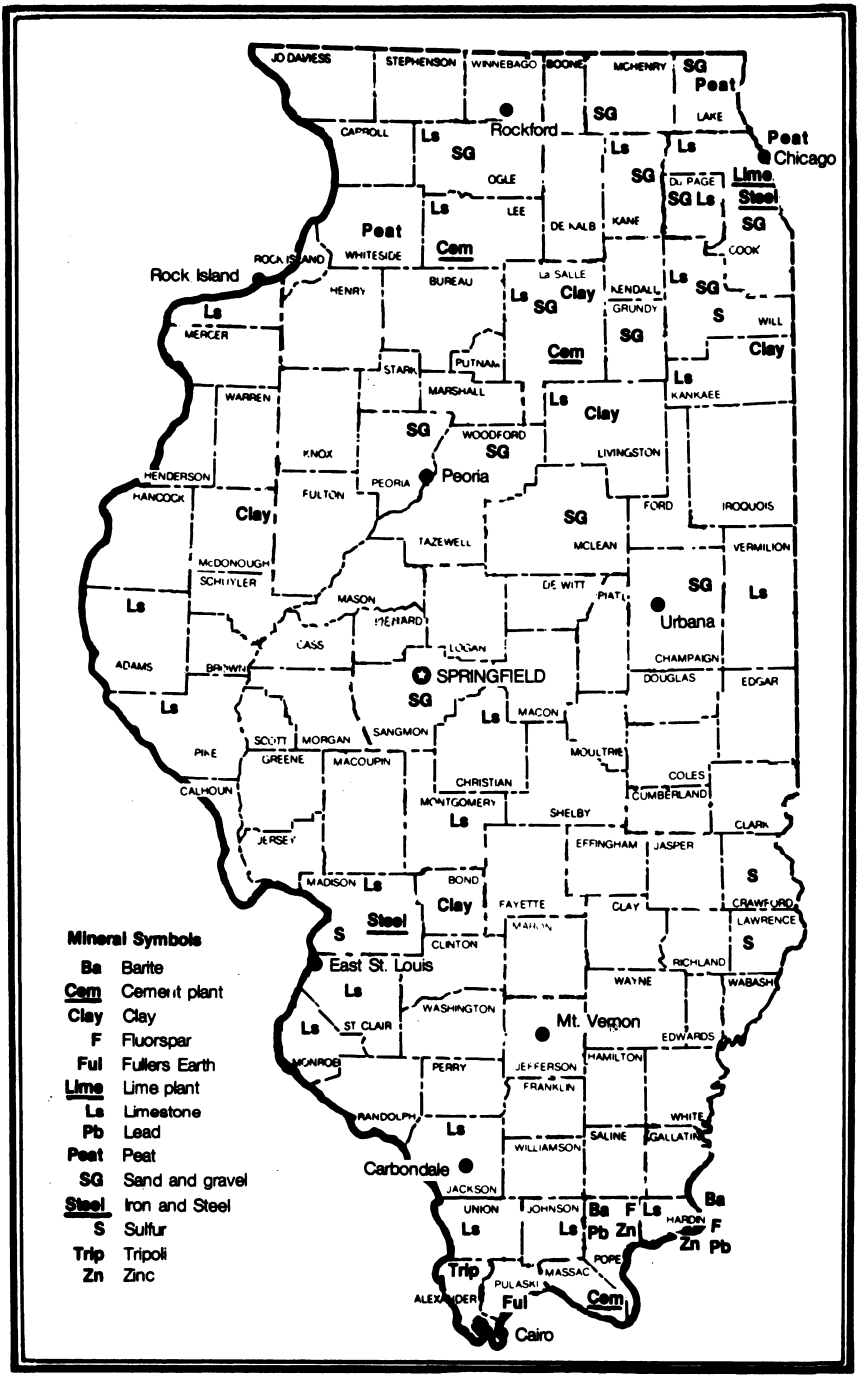

Figure 2.—Principal mineral producing localities in Illinois.

The U.S. Department of Commerce reported a drop of 774 units in permits issued for public and private residential construction in the State after reporting a 59.3% (revised) increase during 1983. The value of nonresidential construction increased about 27%, reaching a value of $2,270.2 million. The relatively stable demand in housing and the increase in nonresidential construction were partly responsible for the increased sales of mineral commodities used in construction.

**Employment.**—The U.S. Department of Labor, Bureau of Labor Statistics, reported that the average monthly employment in mining and quarrying, excluding coal mining and oil and gas extraction, was about 4,800 persons in 1984; 300 workers more than reported in 1983. Average hourly wages increased by $0.40 to $10.82. Average hours worked per week increased to 48.4 hours, compared with 45.6 hours in 1983.

The State's basic steel industry continued to shrink. Average monthly employment was 24,900 in 1984, down from the 26,100 workers reported in 1983. Average hourly wages decreased by $0.48 to $12.95 as steel companies continued to ask for wage concessions to lower costs.

Three mineral industry strikes over contract agreements were reported in the press during 1984. Members of the Oil, Chemical, and Atomic Workers Union were on strike for a 2-week period in February at AMAX Zinc Co. Inc.'s zinc refinery at Sauget. Employees at Missouri Portland Cement Co.'s Joppa plant (members of the Cement Workers Union) went on strike in mid-June when the company asked for concessions after experiencing severe losses for 3 years. After a 2-month period, the company hired new employees to replace striking workers. On April 23, employees of Anna Quarries Inc. in Union County, members of the International Union of Operating Engineers Local 318, went on strike for higher wages. The walkout ended on May 5 when a new 3-year contract was signed.

A strike was averted at Ozark-Mahoning Co.'s fluorspar operations at Rosiclare when a new 3-year contract agreement was ratified by members of the International Association of Machinists in late September.

**Exploration Activities.**—During 1984, Ozark-Mahoning received a fluorspar prospecting permit from the U.S. Forest Service for the Lusk Creek area, Shawnee National Forest, Pope County. The company was allowed to drill up to 54 core holes in the area while exploring for fluorspar deposits.

**Legislation and Government Programs.**—Two bills related to mining were signed by the Governor during 1984. Public Act 83-1234 amended the State's Coal Mining Act to allow a union representative to accompany a State mine inspector on a mine inspection without loss of pay. Following an inspection, mine inspectors are required to discuss findings and recommendations with union representatives and management. Findings and recommendations are to be posted in a conspicuous place.

Public Act 83-1236 became effective on July 31. The act prohibits the Illinois Department of Mines and Minerals from issuing new permits for the use of diesel-powered equipment or explosives underground while miners are working in the mines. The moratorium lasts until January 1, 1986, by which time the State Department of Public Health is to evaluate the dangers and effects that diesel equipment and explosives have on miners and report their findings to the Governor and the Illinois General Assembly.

To better fulfill its mission, the State Geological Survey Division reorganized during 1984 into four groups—mineral resources, general and environmental geology, chemistry and minerals engineering, and administrative services. The survey continued its research programs in environmental geology, geochemistry, geology, hydrology, mineral economics, and mineral resources. Several publications were released during the year. Among them, a set of six 1:500,000-scale maps depicted Illinois' known coal resources in terms of thickness, depth, and tonnage, as well as active mines, mined-out areas, and coal handling facilities. A directory of Illinois sand and gravel and stone producers was also released.

The Illinois Center for Research on Sulfur in Coal (CRSC) was awarded nearly $1.3 million by the Illinois Coal Research Board to continue its study of sulfur and other noxious substances in coal. CRSC is composed of six research institutions in Illinois: Argonne National Laboratory, the State Geological Survey, Northwestern University, Southern Illinois University, the University of Illinois at Chicago, and the University of Illinois at Champaign-Urbana.

Southern Illinois University-Carbondale, the State's Mining and Mineral Resources and Research Institute created under title III of Public Law 95-87, received a grant from the U.S. Bureau of Mines in fiscal year 1984 for operations and research. The Bureau of Mines also had several active contracts and grants with Illinois consulting firms for equipment, research, and services in fiscal year 1984. Funding for these projects totaled $325,236.

The Federal Government distributed $109,126 to the State as its 25% share of revenues for timber sales, grazing rights, recreation, mineral leases, and other uses on the Shawnee National Forest in fiscal year 1984.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Abrasives (Manufactured).**—Silicon carbide was manufactured by ESK Corp., a subsidiary of Wacker Chemical Co., at its plant near Hennepin, Putnam County. The company used a mixture of petroleum coke and silica sand that was treated in on-site furnaces to produce metallurgical and crystalline grades of silicon carbide. Metallurgical grades were used in manufacturing cast iron and steel. Abrasive grades were used in grinding and polishing wheels, as a refractory lining for blast furnaces, and as a cutting agent for wire sawing. Production increased about 28% in 1984.

In April, ESK merged with Exolon Co. of Tonawanda, NY, a major producer of fused aluminum oxide and crude silicon carbide abrasives, to form a new company named Exolon-ESK Co. Management and sales personnel were to be located in Tonawanda where Exolon's processing plant is located.

**Barite.**—Ozark-Mahoning continued to recover barite as a byproduct at its fluorspar operations in Hardin County in southern Illinois. Production and value increased about 52% and 50%, respectively, compared with 1983 figures.

**Cement.**—Illinois ranked 10th nationally in shipments of portland cement and 23d in shipments of masonry cement in 1984. Sales increased for both types of cement. Portland cement sales averaged about $1.01 per short ton more than in 1983; whereas sales of masonry cement averaged about $1.68 per ton less than in 1983.

**Table 4.—Illinois: Portland cement salient statistics**

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 4 | 4 |
| Production | 1,888,713 | 1,876,231 |
| Shipments from mills: | | |
| Quantity | 1,857,430 | 1,996,658 |
| Value | $74,975,215 | $82,621,878 |
| Stocks at mills, Dec. 31 | 229,491 | 118,540 |

Four companies operating eight kilns produced gray portland cement. Plants were operated by Illinois Cement Co., a subsidiary of Centex Corp., and Lone Star Industries Inc. in La Salle County; Dixon-Marquette Cement Inc., a subsidiary of Prairie Materials Sales Inc., in Lee County; and Missouri Portland Cement Co., a division of H. K. Porter Co. Inc., in Massac County. All companies produced Types I and II—general use and moderate heat cements. Illinois Cement also produced Type III, high-early-strength cement. Three companies—Dixon-Marquette, Lone Star, and Missouri Portland—reported sales of masonry cement.

Nearly 76% of the portland cement sales were to ready-mixed concrete companies. The next largest users were concrete product manufacturers and highway contractors. Nearly 99% of all the cement sold was shipped by truck in bulk form.

Approximately 2.7 million short tons of limestone, 117,000 tons of clay, and 88,000 tons of gypsum, along with quantities of imported clinker, fly ash, iron ore, and sand, were used in the manufacture of the State's cement.

About 2.6 million short tons of portland cement and 72,000 tons of masonry cement were consumed in the State.

Employees at Missouri Portland's Joppa plant in Massac County went on strike in mid-June. After 2 months, the company replaced striking workers with new employees. The strike interrupted work at the company's limestone quarry in Hardin County, affecting 28 employees for several weeks.

**Clays.**—Common clay was produced by eight companies operating in five counties. Production was about 253,000 short tons, valued at about $940,000. Livingston County led in production, accounting for 35% of the State's total. Cement companies reported using approximately 117,000 tons of clay in their manufacturing operations. Clay was also used for face brick manufacture, crockery, earthenware, drain tile, and sewer pipe.

Two companies produced fuller's earth—Absorbent Clay Products Co. and Lowe's Southern Clay Inc.; both were in Pulaski County. Output increased less than 1%, but value increased 31%. After processing, fuller's earth was used as animal litter and as an oil and grease absorbent.

**Fluorspar.**—As in previous years, Illinois continued to lead the Nation in production of fluorspar. Shipments and value increased 15% and 14%, respectively, as the Nations' economy recovered. Fluorspar was produced by two companies in 1984. Ozark-Mahoning operated underground mines in Hardin and Pope Counties and produced acid-grade material at its flotation mill in Rosiclare. Hastie Mining Co. produced metallurgical-grade fluorspar from an open pit near Cave In Rock in Hardin County.

Ozark-Mahoning completed shaft sinking and late in the year began production at its new mine, the Annabel Lee, in Hardin County.

Inverness Mining Co. temporarily ceased pumping and ventilating at its Mine No. 1, citing foreign imports as the main reason. The mine had not been operated since 1982. The company continued to dry imported fluorspar and barite to serve its customer base.

**Gem Stones.**—The value of mineral specimens collected by dealers and hobbyists was estimated at $15,000 in 1984. Fluorite, calcite, and barite specimens collected by miners in the Illinois fluorspar district were sold by local rock shops for prices ranging as high as several hundred dollars.

**Gypsum (Calcined).**—National Gypsum Co. processed crude gypsum mined in other States at its plant in Waukegan. Output at the plant more than doubled that of 1983 and exceeded that reported in 1981, the last full year of operation at the plant. The plant was shut down for most of 1982 and a portion of 1983.

**Iron Oxide Pigments (Finished).**—Four companies manufactured iron oxide pigments for use in paint and coatings. Manufacturers were Pfizer Inc., Minerals, Pigments & Metals Div., at East St. Louis in St. Clair County; Prince Manufacturing Co. at Quincy in Adams County; George B. Smith Color Co. at Maple Park in Kane County; and Solomon Grind-Chem Service Inc. at Springfield in Sangamon County. Shipments were about 29,500 short tons, valued at $24.9 million.

**Lime.**—Of 38 States producing lime, Illinois ranked seventh. Production was from three plants in the Chicago area, Cook County. Marblehead Lime Co., a subsidiary of General Dynamics Corp., operated plants at South Chicago and Thornton, and Vulcan Materials Co. operated a plant at McCook. Production and value increased 18% and 19%, respectively. Both companies produced quicklime, and Marblehead Lime also produced hydrated lime. Marblehead Lime's South Chicago plant was ranked as the seventh largest producing lime plant in the United States in 1984. The company was the Nation's largest producer with plants in Illinois, Indiana, Michigan, Pennsylvania, and Utah.

Consumption of lime in Illinois from all domestic sources was 552,000 short tons of quicklime and 112,000 tons of hydrated lime.

Lime was used principally for steelmaking, refractories, water purification, and sulfur removal from stack gases.

**Peat.**—Illinois ranked fourth of 22 States in sales of peat. Production was by four companies in Cook, Lake, and Whiteside Counties in the northern part of the State. Sales and attendant value declined significantly. Most sales were of reed-sedge peat in packaged form. Other types of peat produced were hypnum and humus. Peat was sold mainly for general soil improvement. Other sales were for earthworm culture medium, golf courses, ingredient for potting soils, mushroom beds, nursery uses, and vegetable growing.

**Perlite (Expanded).**—Illinois ranked third nationally in sales of expanded perlite. Sales dropped about 1% during 1984, but the value increased 4%. Three companies expanded perlite mined in Western States at plants in northeastern Illinois. Silbrico Corp. operated a plant in Cook County; Strong-Lite Products Corp. of Illinois, a plant in De Kalb County; and Manville Products Corp., a plant in Will County. Expanded perlite was used for agricultural purposes, concrete and plaster aggregates, cavity fill insulation, fillers, low-temperature insulation, and roof insulation board.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Nationally, Illinois ranked eighth in output of construction sand and gravel, dropping from the fifth place it held in 1982, the last previous year of a complete canvass. Compared with 1983 figures, production and value increased 23% and 24%, respectively, because of increased construction activity. Mining occurred in 61 of the State's 102 counties by 131 companies and government agencies. Kane County led the State's production with about 4.3 million short tons, followed by McHenry County with 4.1 million tons. Most of the State's construction sand and gravel was transported by truck.

## Table 5.—Illinois: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,546 | $9,931 | $2.80 |
| Plaster and gunite sands | 206 | 594 | 2.88 |
| Concrete products | 354 | 956 | 2.70 |
| Asphaltic concrete | 3,345 | 11,684 | 3.49 |
| Road base and coverings[1] | 4,023 | 11,359 | 2.82 |
| Fill | 2,800 | 5,805 | 2.07 |
| Snow and ice control | W | W | 2.31 |
| Railroad ballast | W | W | 3.25 |
| Other | 11,694 | 32,148 | 2.75 |
| Total or average | [2]25,969 | 72,477 | 2.79 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes road and other stabilization (cement and lime).

[2] Data do not add to total shown because of independent rounding.

## Table 6.—Illinois: Construction sand and gravel sold or used by producers, by county

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Bond | 2 | W | W | 3 | 197 | $485 |
| Boone | 1 | 91 | $267 | 2 | W | W |
| Bureau | 3 | 157 | 475 | 3 | 300 | 1,087 |
| Cass | 2 | ([1]) | ([1]) | -- | -- | -- |
| Champaign | 6 | 446 | 1,422 | 6 | 639 | 1,990 |
| Cook | 2 | W | W | 3 | 509 | 1,523 |
| Cumberland | 1 | 101 | 248 | 3 | 203 | 444 |
| De Kalb | 6 | 93 | 293 | 3 | 117 | 348 |
| De Witt | 1 | 35 | 139 | 1 | W | W |
| Effingham | 1 | W | W | 1 | W | ([1]) |
| Jo Daviess | 1 | 193 | 373 | 1 | W | W |
| Kane | 12 | 4,896 | 13,551 | 13 | 4,261 | 13,254 |
| Kendall | 2 | W | W | 3 | 78 | 158 |
| Lake | 2 | W | W | 3 | 2,259 | 4,557 |
| La Salle | 5 | W | W | 7 | 429 | 1,102 |
| Lawrence | 1 | W | W | 3 | 341 | 877 |
| Logan | 3 | 335 | 833 | 2 | W | W |
| McHenry | 16 | 3,615 | 9,663 | 15 | 4,079 | 11,253 |
| McLean | 6 | 704 | 2,441 | 4 | 682 | 3,021 |
| Mason | 2 | W | W | 1 | 10 | 24 |
| Massac | 3 | 27 | 37 | 2 | 15 | 21 |
| Morgan | -- | -- | -- | 2 | ([1]) | ([1]) |
| Moultrie | 1 | W | W | 1 | 12 | W |
| Peoria | 6 | 526 | 1,030 | 7 | 632 | 1,619 |
| Piatt | 21 | 124 | 377 | 3 | W | W |
| Putnam | 3 | 19 | 41 | 3 | 41 | 118 |
| Sangamon | 4 | 701 | 2,418 | 4 | 541 | 1,659 |
| Schuyler | 1 | 70 | 245 | -- | -- | -- |
| Stephenson | 2 | W | W | 2 | W | 141 |
| Tazewell | 10 | 598 | 2,053 | 5 | 239 | 764 |
| Vermilion | 3 | 104 | 238 | 3 | 110 | 195 |
| Whiteside | 3 | 212 | 605 | 3 | 147 | 302 |
| Will | 6 | 889 | 2,708 | 7 | 641 | 1,586 |
| Winnebago | 3 | 159 | 345 | 5 | 254 | 508 |
| Woodford | 7 | 650 | 2,239 | 6 | 899 | 3,083 |
| Undistributed[2] | 37 | 6,812 | 17,103 | 60 | 8,333 | 22,357 |
| Total[3] | 185 | 21,557 | 59,149 | 190 | 25,969 | 72,477 |

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Less than 1/2 unit.

[2] Includes Adams, Alexander (1984), Clark (1982), Clinton, Coles, Crawford (1984), Du Page, Fayette, Ford, Fulton, Gallatin, Grundy, Hancock (1982), Henderson (1984), Henry, Jackson (1984), Kankakee, Knox (1984), Livingston (1984), Macon, Madison, Marshall, Ogle (1984), Pike, Pulaski, Randolph, Rock Island, St. Clair, Wabash, and White Counties, sand and gravel that cannot be assigned to specific counties (1984), and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—Illinois ranked first nationally in the production of industrial sand with output of about 4.1 million short tons in 1984. Production and value increased about 1% and 22%, respectively. Six companies produced from eight pits in La Salle, Mason, and Ogle Counties. La Salle County led the State's production. As in previous years, the greatest sales were for glass manufacture and foundry applications. Sand ground for fillers commanded the highest average unit value, reaching $31.80 per ton. Average value for all uses was $12.73 per ton compared with $10.56 per ton in 1983. Most industrial sand was shipped to the point of use by truck.

On August 1, Martin Marietta Corp. agreed to lease, with option to purchase, its remaining industrial sand operation to Wedron Silica Co., a new corporation formed by a group of Martin Marietta employees and Best Sand Corp. of Chardon, OH. The firm sold its other two Illinois operations, near Oregon and Troy Grove, to Unimin Corp. of New Canaan, CT, in September 1983.

**Slag—Iron and Steel.**—Illinois ranked eighth of 22 States in sales of processed iron and steel slag. Four companies processed slag from the State's iron and steel furnaces for use by the construction industry. Sales dropped about 18% during 1984.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Crushed stone continued as the leading nonfuel mineral produced in the State, contributing 41% of the total output value in 1984. Production was estimated to be 48.5 million short tons in 1984, about 13% higher than that reported in 1983 because of increased construction activity.

Material Service Corp. of Chicago acquired the Martin Marietta stone quarry in Lincoln that produces approximately 250,000 tons per year.[3]

A new business was launched near Cave In Rock during 1984 by a partnership of Hastie Mining, Denny & Simpson Stone Co., and Rigsby & Barnard Quarry and Construction Inc., all operating in Hardin County. The new partnership, named Rock Dust Products, planned to sell crushed limestone for dusting coal mines and as a filler for asphalt roofing. New markets were also being investigated.

*Dimension.*—Granite Technologies Inc., a company based in Paris, France, began construction of a stone cutting plant in the Chicago area to cut and polish imported granite and marble slabs for the construction industry. High-productivity cutting and polishing equipment was imported from Italy for installation in the plant, which was expected to employ about 100 persons.

**Sulfur (Recovered).**—Sulfur was recovered at the petroleum refining operations of five companies in Crawford, Lawrence, Madison, and Will Counties. About 181,000 metric tons of sulfur was sold at an average value of $87.37 per ton.

**Tripoli.**—Illinois continued to rank first of three States in the production of tripoli. Output increased about 4% during 1984, but the average value per short ton dropped by $0.51. Two companies, Illinois Minerals Co. and Tammsco Inc., produced from mines in Alexander County, the southernmost county in the State.

Most tripoli sales were for fillers for the paint, plastic, and rubber industries. Lesser quantities were sold as an abrasive for buffing and polishing compounds, soap, and toothpaste.

In February, Tammsco was sold to K & W Engineering Co. of Nashville, TN. The company's plant was upgraded during 1984, which resulted in a production increase of about 22%.[4]

**Vermiculite (Exfoliated).**—Illinois ranked seventh of 29 States in production of exfoliated vermiculite. Sales increased about 70% because of the expanding construction market. Three companies processed crude vermiculite received from out-of-State sources. Producers were W. R. Grace & Co. at West Chicago, Du Page County; International Vermiculite Co. at Girard, Macoupin County; and Strong-Lite Products Corp. of Illinois at De Kalb, De Kalb County. Sales were for agricultural purposes, block insulation, concrete aggregate, fire proofing, high-temperature insulation, loose-fill insulation, and plaster aggregate.

## METALS

**Iron and Steel.**—Illinois ranked sixth of 12 States in shipments of pig iron, dropping from fifth place in 1983. Shipments increased about 10%, to 3 million short tons in 1984 but remained less than one-half of the record high 7.9 million tons shipped in 1973.

The State's steel industry continued its restructuring efforts throughout 1984 in order to cut costs and remain competitive.

United States Steel Corp. terminated 500 management and administrative personnel at the end of August at its mills in Chicago and Gary, IN, in its cost-cutting efforts. The firm also became enjoined in a lawsuit filed by the United Steelworkers of America and the State of Illinois, who sought to force the company to fulfill its promise to build a $225 million rail mill at the South Works that it had announced in 1981. The lawsuit was not settled at yearend.

National Intergroup Inc. sold one-half of its National Steel Corp. to Japan's second largest steel company, Nippon Kokan K.K. The sale included National's Granite City Steel Div. at Granite City.

Granite City Steel completed a $5.5 million project to upgrade its hot-strip mill and install new computer facilities in 1984.

The Economic Development Administration (EDA) sold the Wisconsin Steel Corp. plant and equipment in South Chicago for scrap to Cuyahoga Wrecking Corp., Long Island City, NY, for a minimum bid of $3 million. EDA had been trying to sell the facility for several years after acquiring it at a bankruptcy auction when Wisconsin Steel defaulted on $60 million of EDA-guaranteed loans.

**Lead, Silver, and Zinc.**—Ozark-Mahoning continued to recover byproduct lead, silver, and zinc at its flotation plant near Rosiclare from fluorspar ores mined in Hardin and Pope Counties. Production increased substantially because of the corresponding increase in fluorspar production.

**Other Metals.**—Allied Metal Co. of Chicago, a processor of secondary aluminum, purchased at a bankruptcy auction Harco Aluminum Co.'s Chicago plant that had been closed since 1982. The plant will be used to process scrap for smelting at Allied's two other plants in the Chicago area.

Magma Copper Co., a subsidiary of Newmont Mining Corp., purchased AT&T Technologies' closed Hawthorne Works in Cicero. The continuous cast copper rod mill had an annual capacity of 140,000 short tons. It was slated to reopen in 1985.

Samuel G. Keywell Co. opened a new stainless steel and alloy scrap processing facility in Chicago to serve the specialty steel industry. The facility was fully automated and equipped with a wet and dry laboratory to test incoming scrap materials. The facility's location will allow the company to export scrap if domestic demand is not sufficient to absorb the plant's tonnage.

T. L. Diamond Inc., of New York City, purchased the Sherwin-Williams Co.'s zinc oxide plant in Hillsboro that was shut down in mid-1983. The operation, known as Eagle Zinc Co. of Hillsboro, a division of T. L. Diamond, will produce zinc oxide for the paint, rubber, petroleum, chemical, and agricultural industries.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN.

[2] Editorial assistant, Bureau of Mines, Minneapolis, MN.

[3] Chicago Tribune. Material Service Buys Quarry. Mar. 10, 1984.

[4] The Cairo Evening Citizen. Tammsco Goes From Near Closing to Expansion. Apr. 13, 1984, p. 4.

**Table 7.—Principal producers**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Abrasives (manufactured): | | | |
| Exolon-ESK Co | Box 412<br>Hennepin, IL 61327 | Plant | Putnam. |
| Cement: | | | |
| Dixon-Marquette Cement Inc., a subsidiary of Prairie Materials Sales Inc. | 6406 Joliet Rd.<br>Countryside, IL 60525 | do | Lee. |
| Illinois Cement Co., a subsidiary of Centex Corp. | Box 442<br>La Salle, IL 61301 | do | La Salle. |
| Lone Star Industries Inc., Cement and Construction Materials Group. | 1 Greenwich Plaza<br>Box 5050<br>Greenwich, CT 06836 | do | Do. |
| Missouri Portland Cement Co., a division of H. K. Porter Co. Inc. | Box 147<br>Joppa, IL 62953 | do | Massac. |
| Clays: | | | |
| Absorbent Clay Products Co | Box 120<br>Anna, IL 62906 | Pit and plant | Pulaski. |
| Lowe's Southern Clay Inc | 348 South Columbia<br>South Bend, IN 46624 | do | Do. |
| Streator Brick Systems Inc | West 9th St.<br>Streator, IL 61364 | do | Livingston. |
| Fluorspar: | | | |
| Hastie Mining Co | Cave In Rock, IL 62919 | Open pit | Hardin. |
| Ozark-Mahoning Co.[1] | Box 57<br>Rosiclare, IL 62982 | Underground mines and plant. | Hardin and Pope. |
| Gypsum (calcined): | | | |
| National Gypsum Co | Box 139<br>Waukegan, IL 60085 | Plant | Lake. |

See footnotes at end of table.

## Table 7.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Iron oxide pigments (finished): | | | |
| Pfizer Inc., Minerals, Pigments & Metals Div. | 2001 Lynch Ave.<br>East St. Louis, IL 62201 | Plant | St. Clair. |
| Prince Manufacturing Co | 700 Lehigh St.<br>Bowmanstown, PA 18030 | do | Adams. |
| Iron and steel: | | | |
| Granite City Steel Div. of National Steel Corp. | Box 365<br>Granite City, IL 62040 | Iron and steel furnaces. | Madison. |
| Interlake Inc | 13500 South Perry Ave.<br>Riverdale, IL 60627 | do | Cook. |
| Republic Steel Corp | 1629 Republic Bldg.<br>Cleveland, OH 44101 | do | Do. |
| United States Steel Corp | 3426 East 89th St.<br>Chicago, IL 60617 | do | Do. |
| Lime: | | | |
| Marblehead Lime Co., a subsidiary of General Dynamics Corp. | 300 West Washington St.<br>Chicago, IL 60606 | Plants | Do. |
| Vulcan Materials Co | Joliet Rd. and 53d St.<br>McCook, IL 60525 | Plant | Do. |
| Peat: | | | |
| Hyponex Corp | 2013 South Anthony Blvd.<br>Fort Wayne, IN 46803 | Bog and processing plant. | Whiteside. |
| Markman Peat Co | Route 3<br>Morrison, IL 61270 | do | Do. |
| Perlite (expanded): | | | |
| Manville Products Corp | Box 864<br>Joliet, IL 60434 | Plant | Will. |
| Silbrico Corp | 6300 South River Rd.<br>Hodgkins, IL 60525 | do | Cook. |
| Sand and gravel: | | | |
| Construction: | | | |
| R. A. Cullinan & Sons Inc | 121 West Park St.<br>Tremont, IL 61568 | Pits and plants | Various. |
| Elmhurst-Chicago Stone Co | 400 West 1st St.<br>Elmhurst, IL 60126 | do | Cook, Du Page, Kane. |
| General Dynamics Corp.: | | | |
| Material Service Corp | 300 West Washington St.<br>Chicago, IL 60606 | do | Grundy, Kane, McHenry. |
| Yackley Material Service | 1504 Ogden Ave.<br>Lisle, IL 60532 | Pit and plant | Will. |
| Meyer Material Co | Route 2, Box 56<br>Algonquin, IL 60102 | Pits and plants | Kane and McHenry. |
| Thelen Sand & Gravel | 28955 West Route 173<br>Antioch, IL 60002 | Pit and plant | Lake. |
| Vulcan Materials Co | Box 6<br>Countryside, IL 60525 | Pits and plants | Champaign, Livingston, McHenry, Macon. |
| Industrial: | | | |
| Manley Bros. of Indiana Inc | Box 538<br>Chesterton, IN 46304 | Pit and plant | La Salle. |
| Ottawa Silica Co | Box 577<br>Ottawa, IL 61350 | do | Do. |
| Unimin Corp | 258 Elm St.<br>New Canaan, CT 06840 | Pits and plants | La Salle and Ogle. |
| Wedron Silica Co | Box 167<br>Wedron, IL 60557 | Pit and plant | La Salle. |
| Stone (crushed limestone, 1983): | | | |
| Anna Quarries Inc | Box 180<br>Anna, IL 62906 | Quarry and plant | Union. |
| Columbia Quarry Co | Box 128<br>Columbia, IL 62236 | Underground mine, quarries, plants. | Johnson, Monroe, Pulaski, St. Clair, Union. |
| Material Service Corp., a subsidiary of General Dynamics Corp. | 300 West Washington St.<br>Chicago, IL 60606 | do | Cook, Henderson, Logan, Menard, Montgomery, St. Clair, Vermilion, Will. |
| Moline Consumers Co | 313 16th St.<br>Moline, IL 61265 | Quarries and plants. | Adams, Hancock, Henry, La Salle, McDonough, Pike, Rock Island, Warren. |
| Vulcan Materials Co | Box 6<br>Countryside, IL 60525 | do | Cook, Kankakee, Livingston, Will. |
| Sulfur (recovered): | | | |
| Mobil Oil Corp | Box 874<br>Joliet, IL 60434 | Plant | Will. |
| Shell Oil Co | Box 262<br>Wood River, IL 62095 | do | Madison. |
| Union Oil Co. of California | 1650 East Golf Rd.<br>Schaumburg, IL 60196 | do | Will. |

## Table 7.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Tripoli: | | | |
| Illinois Minerals Co., a subsidiary of Georgia Kaolin Co. | 2035 Washington Ave.<br>Cairo, IL 62914 | Underground and open pit mines and plant. | Alexander. |
| Tammsco Inc | Box J<br>Tamms, IL 62988 | Underground mine and plant. | Do. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 6051 West 65th St.<br>Bedford Park, IL 60638 | Plant | Du Page. |
| International Vermiculite Co | 1st and Mound Sts.<br>Girard, IL 62640 | do | Macoupin. |
| Strong-Lite Products Corp. of Illinois | 1120 Oak St.<br>De Kalb, IL 60115 | do | De Kalb. |

[1] Also barite, lead, silver, and zinc.

# The Mineral Industry of Indiana

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Indiana Department of Natural Resources, for collecting information on all nonfuel minerals.**

## By William A. Bonin[1]

In 1984, Indiana's nonfuel mineral production, which included very large shipments of cement and lime, was valued at $293.2 million. For the second consecutive year, total value increased over that of the previous year—17% in 1984, following a 17.4% gain in 1983. The value of all nonfuel mineral commodities and materials, except peat and crude gypsum, rose sharply above the significant gains posted in 1983. The $42.7 million 1984 increase in value ranked Indiana 25th in the Nation, up from 26th in 1983.

The State ranked second nationally in the production of dimension stone, shipments of masonry cement, and sales of iron slag. It also ranked third in sales of peat, seventh in gypsum production, and eighth among the 38 lime manufacturing States. Other commodities produced were crushed stone, construction sand and gravel, portland cement, common clay and shale, industrial sand, steel slag, natural abrasives, and fire clay. Indiana also continued to lead in pig iron and raw steel production and ranked fifth among the 16 aluminum producing States. Elemental sulfur was recovered as a nondiscretionary byproduct of oil refining. Perlite was shipped into Indiana for processing, and the State ranked eighth among 32 States in sales of expanded perlite.

**Table 1.—Nonfuel mineral production in Indiana[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays[2] thousand short tons | 558 | $1,421 | 653 | $2,085 |
| Gem stones | NA | 1 | NA | 1 |
| Peat thousand short tons | 81 | 1,973 | 61 | 1,358 |
| Sand and gravel: |  |  |  |  |
| Construction do | [e]14,400 | [e]37,900 | 16,071 | 44,744 |
| Industrial do | W | W | 194 | 1,129 |
| Stone: |  |  |  |  |
| Crushed do | 24,051 | 82,782 | [e]26,700 | [e]99,400 |
| Dimension do | 144 | 11,015 | [e]159 | [e]14,269 |
| Combined value of abrasives (natural), cement, clays (fire clay), gypsum, lime, and value indicated by symbol W | XX | 115,450 | XX | 130,250 |
| Total | XX | 250,542 | XX | 293,236 |

[e]Estimated. NA Not available. W Withheld to avoid disclosing proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fire clay; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Indiana, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adams | $232 | W | Stone (crushed). |
| Allen | W | W | Stone (crushed), peat. |
| Bartholomew | 362 | W | Stone (crushed). |
| Blackford | -- | W | Do. |
| Boone | W | (2) | |
| Carroll | 122 | W | Stone (crushed). |
| Cass | W | W | Cement, stone (crushed), clays. |
| Clark | W | W | Do. |
| Clay | W | W | Clays. |
| Clinton | W | (2) | |
| Crawford | (3) | W | Stone (crushed). |
| Daviess | W | (2) | |
| Dearborn | W | (2) | |
| Decatur | (3) | W | Stone (crushed). |
| De Kalb | 642 | (2) | |
| Delaware | 232 | $939 | Stone (crushed). |
| Dubois | 1 | W | Clays. |
| Elkhart | 814 | W | Stone (crushed). |
| Fayette | W | (2) | |
| Fountain | W | W | Clays. |
| Franklin | W | W | Stone (crushed), stone (dimension). |
| Fulton | W | W | Peat. |
| Gibson | W | (2) | |
| Grant | W | W | Stone (crushed). |
| Greene | W | (2) | |
| Hamilton | W | W | Stone (crushed), peat. |
| Hancock | W | (2) | |
| Harrison | 221 | 1,046 | Stone (crushed). |
| Henry | W | (2) | |
| Howard | W | W | Stone (crushed). |
| Huntington | 444 | W | Do. |
| Jackson | W | W | Clays. |
| Jasper | W | W | Stone (crushed), peat. |
| Jay | W | W | Stone (crushed). |
| Jennings | (3) | W | Do. |
| Knox | 776 | (2) | |
| Kosciusko | W | (2) | |
| Lagrange | W | W | Stone (crushed). |
| Lake | W | W | Lime. |
| La Porte | W | W | Peat, sand and gravel (industrial). |
| Lawrence | W | 33,315 | Cement, stone (dimension), stone (crushed). |
| Madison | W | W | Stone (crushed), peat. |
| Marion | 3,916 | W | Stone (crushed). |
| Marshall | W | (2) | |
| Martin | W | W | Gypsum. |
| Miami | 139 | W | Stone (crushed). |
| Monroe | (3) | 7,963 | Stone (crushed), stone (dimension). |
| Montgomery | 6 | (2) | |
| Morgan | W | W | Clays, stone (crushed). |
| Newton | (3) | W | Stone (crushed). |
| Noble | W | (2) | |
| Ohio | 58 | (2) | |
| Orange | W | W | Stone (crushed), abrasives. |
| Owen | W | W | Stone (crushed). |
| Parke | 329 | (2) | |
| Perry | (3) | W | Stone (crushed). |
| Porter | W | W | Sand (industrial). |
| Pulaski | (3) | W | Stone (crushed). |
| Putnam | W | W | Cement, stone (crushed), clays, stone (dimension). |
| Randolph | W | W | Stone (crushed). |
| Ripley | (3) | W | Do. |
| Rush | 4 | W | Stone (crushed), stone (dimension). |
| St. Joseph | 1,759 | 2 | Stone (crushed). |
| Scott | (3) | W | Do. |
| Shelby | 507 | W | Do. |
| Starke | 125 | (2) | |
| Steuben | 261 | (2) | |
| Sullivan | W | 58 | Stone (crushed). |
| Switzerland | W | 52 | Do. |
| Tippecanoe | W | (2) | |
| Vanderburgh | 241 | (2) | |
| Vermillion | 717 | W | Clays. |
| Vigo | 662 | (2) | |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Indiana, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Wabash | $34 | (2) | |
| Warren | 1,183 | (2) | |
| Washington | (3) | $596 | Stone (crushed). |
| Wayne | 1,234 | W | Do. |
| Wells | W | W | Stone (crushed), peat. |
| White | (3) | (2) | Stone (crushed). |
| Whitley | W | (2) | |
| Undistributed[4] | 121,278 | 168,671 | |
| Sand and gravel (construction) | XX | 37,900 | |
| Stone: | | | |
| Crushed | e65,500 | XX | |
| Dimension | r e11,626 | XX | |
| Total | r 5213,424 | 250,542 | |

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Indiana business activity

| | | 1982r | 1983 | 1984p |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 5,482 | 5,472 | 5,498 |
| Total civilian labor force | do | 2,599 | 2,578 | 2,627 |
| Unemployment | do | 310 | 286 | 226 |
| Employment (nonagricultural): | | | | |
| Mining total | do | 10.3 | 9.7 | 10.2 |
| Nonmetallic minerals except fuels[1] | do | 2.7 | 2.7 | NA |
| Coal mining[1] | do | 6.7 | 6.1 | NA |
| Oil and gas extraction[1] | do | .9 | .9 | NA |
| Manufacturing total | do | 589.0 | 581.6 | 621.1 |
| Primary metal industries | do | 87.6 | 82.4 | 80.3 |
| Stone, clay, and glass products | do | 19.1 | 18.3 | 18.9 |
| Chemicals and allied products | do | 29.0 | 29.0 | 29.5 |
| Petroleum and coal products | do | 4.0 | 4.0 | 4.1 |
| Construction | do | 77.1 | 74.8 | 80.7 |
| Transportation and public utilities | do | 103.4 | 102.6 | 105.5 |
| Wholesale and retail trade | do | 459.9 | 466.4 | 492.7 |
| Finance, insurance, real estate | do | 102.7 | 101.4 | 103.6 |
| Services | do | 356.9 | 366.1 | 387.3 |
| Government and government enterprises | do | 328.7 | 327.0 | 330.3 |
| Total | do | 2,028.0 | [2]2,209.5 | 2,131.4 |
| Personal income: | | | | |
| Total | millions | $55,141 | $57,646 | $64,418 |
| Per capita | | $10,058 | $10,534 | $11,717 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 41.0 | 41.7 |
| Total average hourly earnings, production workers | | $9.79 | $10.10 | $10.45 |
| Earnings by industry: | | | | |
| Farm income | millions | $660 | $64 | $1,334 |
| Nonfarm | do | $38,736 | $41,026 | $45,090 |
| Mining total | do | $371 | $336 | $387 |
| Nonmetallic minerals except fuels | do | $53 | $55 | $61 |
| Coal mining | do | $252 | $241 | $281 |
| Oil and gas extraction | do | $67 | $40 | $45 |
| Manufacturing total | do | $14,890 | $15,544 | $17,479 |
| Primary metal industries | do | $2,875 | $2,789 | $2,887 |
| Stone, clay, and glass products | do | $440 | $454 | $492 |
| Chemicals and allied products | do | $916 | $947 | $1,056 |
| Petroleum and coal products | do | $170 | $175 | $194 |
| Construction | do | $1,977 | $2,025 | $2,168 |
| Transportation and public utilities | do | $2,907 | $3,084 | $3,248 |
| Wholesale and retail trade | do | $5,853 | $6,157 | $6,727 |
| Finance, insurance, real estate | do | $1,749 | $1,927 | $2,081 |
| Services | do | $5,798 | $6,416 | $7,117 |
| Government and government enterprises | do | $5,094 | $5,435 | $5,773 |

See footnotes at end of table.

Table 3.—Indicators of Indiana business activity —Continued

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 12,783 | 16,131 | 19,859 |
| Value of nonresidential construction ... millions | $713.4 | $875.2 | $1,054.8 |
| Value of State road contract awards ... do | $139.2 | $165.3 | $309.3 |
| Shipments of portland and masonry cement to and within the State ... thousand short tons | 1,076 | 1,216 | 1,324 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value ... millions | $213.4 | $250.5 | $293.2 |
| Value per capita | $39 | $46 | $53 |

[p] Preliminary. [r] Revised. NA Not available.
[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

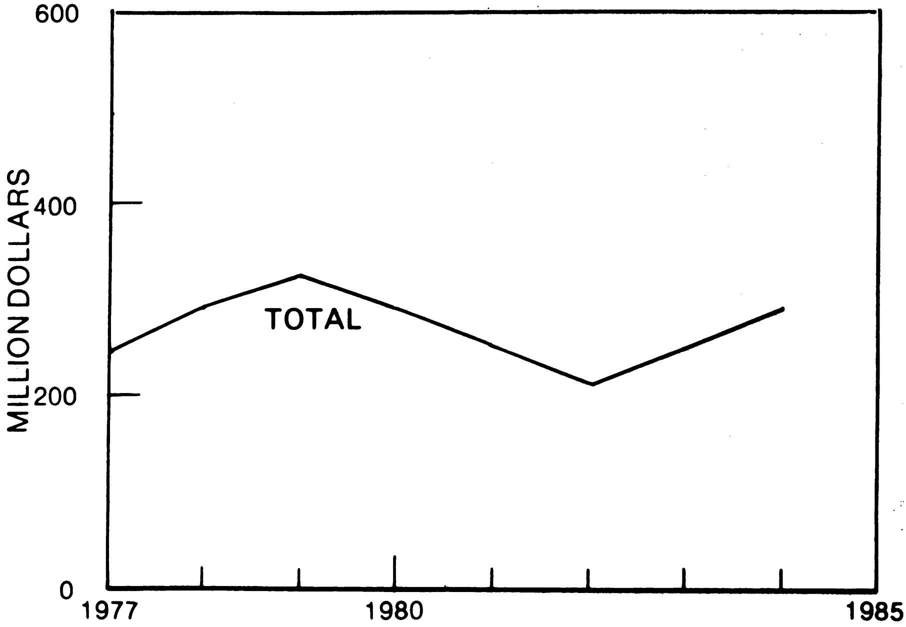

Figure 1.—Total value of nonfuel mineral production in Indiana.

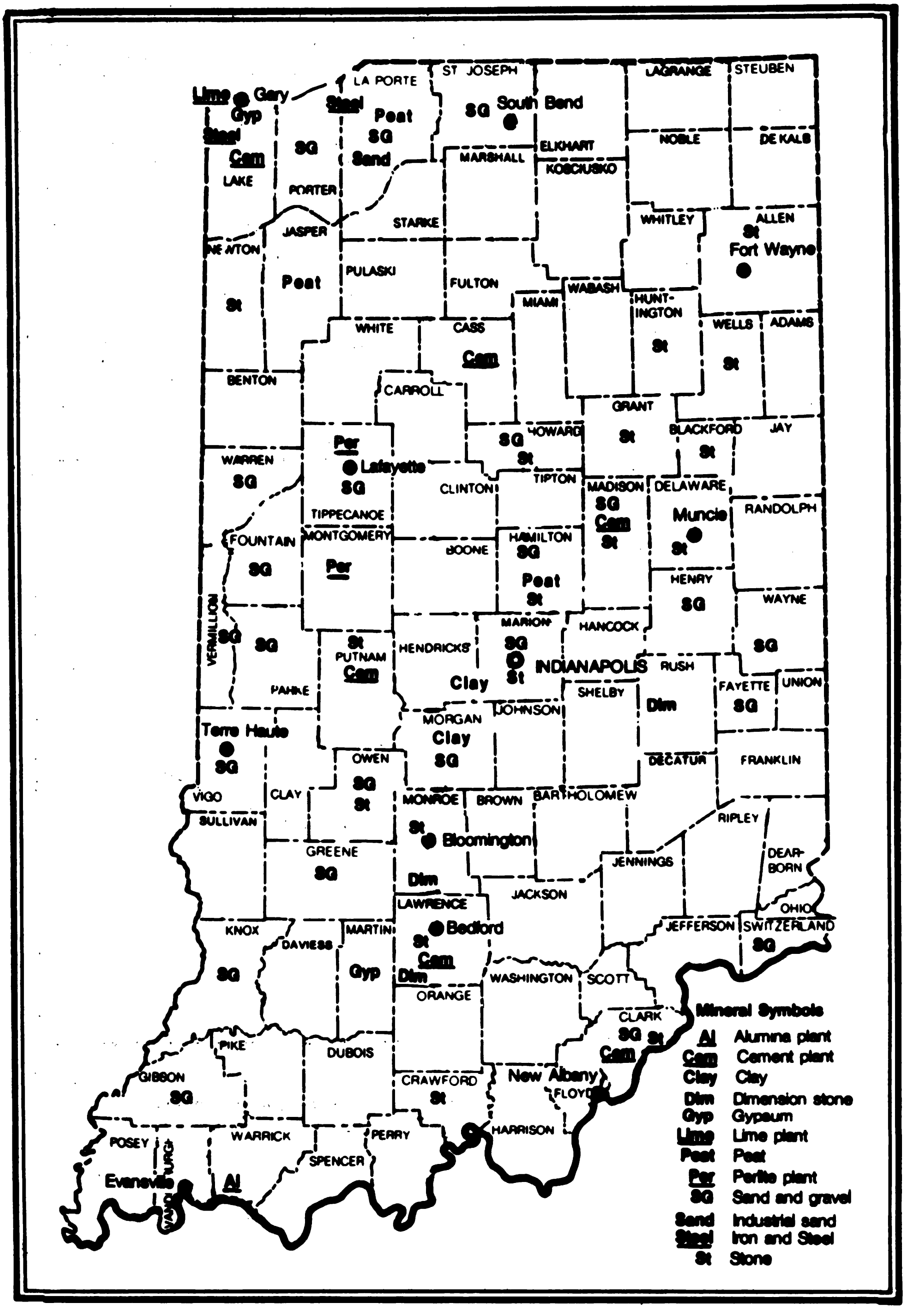

**Figure 2.—Principal mineral producing localities in Indiana.**

**Trends and Developments.**—Continued general economic recovery was reflected in the State's nonfuel mineral industries, since all the industrial mineral commodities, except crude gypsum, showed substantial increases in both quantity and value.

Domestic steel production, a major indicator of material use and mineral production, continued to recover from the very low levels of 1982. However, Indiana's steelmakers did not make gains in 1984. On the positive side in the metals sector, significant progress continued to be made at the State's only primary aluminum smelter. On a modest increase in output, earnings were significantly better than in 1983 at the fully integrated facility that produces light-gauge sheet for beverage containers.

Several companies continued to pursue oil shale development in a four-county area of southeastern Indiana. Three projects received grants, contingent on Federal funding, from the Indiana Corp. for Science & Technology, a publicly funded corporation authorized by the State legislature in 1982 to promote development of new industry in the State. Two projects, one an in situ operation and the other using surface-mined shale, received letters of funding intent from the U.S. Department of Energy, and a third project was one of four finalists for funding consideration from U.S. Synthetic Fuels Corp.

**Legislation and Government Programs.**—The State program for certification of professional geologists was administered by the Indiana Geological Survey (IGS). At yearend, 611 individuals had been certified. Also, during 1984, the IGS was involved in the activities of the Indiana Energy Development Board and its several committees. The IGS reported that organic-rich Pennsylvanian Shale might be mined profitably along with coal in strip mining operations. Some of these shales, though thinner and less predictable in occurrence, have a higher oil yield than the New Albany Shale, which had been receiving much prior attention. The IGS issued the first 6 maps of a new series of 19 county maps showing locations of present and past underground coal mining operations.

Also in fuels, the IGS continued mapping the distribution of Mississippian units beneath the basal Pennsylvanian rocks and the position of that unconformity. The IGS study of Indiana gasfields, covering both historic and current gas production, was nearing completion.

By the end of 1984, the final review of the "Annotated Bibliography of Indiana Geology, 1956-75" was completed. Publication was scheduled for 1985. The post-1975 works were in progress.

The IGS 7-year mapping project that characterizes faulting and jointing in southern Indiana was completed. These maps are included in a report published by the Nuclear Regulatory Commission, which funded part of the project.

The IGS Miscellaneous Map 41, "Map of Indiana Showing Location of Coal and Industrial Minerals Operations," was published in early fall.

The "Bedrock Map of Indiana," a project begun in 1977 and completed during the year, will be the first single-sheet bedrock map of the State published at a scale of 1:500,000. It joins the already published Regional Geologic Map, the bedrock surface topographic map, and the thickness of unconsolidated deposit map. The Quaternary (unconsolidated) deposits map is the only one yet to be completed in the planned modern series for the State.

In support of the State's ceramic producers, the IGS continued to send numerous samples from core and from outcrops of clay and shale to the U.S. Bureau of Mines Tuscaloosa Research Center in Alabama for analysis and evaluation. Information resulting from this cooperative effort has been used by several private companies and State agencies. The location of a $6.2 million tile manufacturing plant in Bloomfield by a Taiwan tile manufacturing firm was aided by work of the IGS and the U.S. Bureau of Mines. The KPT Inc. plant, scheduled to be operational by April 1986, was expected to employ 60 people and have an expected annual payroll of $1.6 million. Also, in the area of mine safety and health, the IGS continued to determine the methane content of coalbeds in Indiana using the desorption method developed by the U.S. Bureau of Mines.

On July 1, 1984, as in previous years, allotment grants were made to Purdue University at West Lafayette, one of 31 designated mining and mineral resources and research institutes. The authorization for the mineral institutes program, now in its seventh year, was extended through fiscal year 1989. Designation of a research-oriented school of higher education as a mineral institute creates a focal point for mineral engineering research in support of the mineral industry. Purdue University was also an affiliate of the University of Missouri at Rolla, one of the five generic mineral technology centers in the United States with expertise in the area of pyrometallurgy.

New proposed antipollution rules issued in November by the U.S. Environmental Protection Agency will limit the pollution control credit that a utility can receive for tall stacks. To meet the proposed air pollution limits, utilities will have to install scrubbers or switch to low-sulfur coal. The Indiana Coal Council, speaking for the industry, indicated that utilities would prefer the latter rather than install scrubbers.

In response to the draft "Land and Resource Management Plan" (Forest Plan) and the "Environmental Impact Statement," which were made available for review and comment in January 1984, 764 letters were received at the Hoosier National Forest. Comments on forest use covered the spectrum from total preservation to increased mineral development and timber harvest. Publication of the final Forest Plan and Environmental Statement is anticipated in early 1985. In April 1983, the U.S. Bureau of Land Management had decided not to issue leases to explore and drill for oil and gas in the Hoosier National Forest until the Forest Plan was completed.

There are 644,139 acres within the Hoosier National Forest boundary, of which 187,523 acres (29%) are in National Forest ownership. During 1984, an additional 229 acres were purchased. While crushed stone was the only nonfuel mineral commodity produced from forest lands, there are potentially valuable quantities of clay and shale, coal, gypsum, sand and gravel, silica, abrasive stone, and building stone within the forest. During 1984, there were 5 oil and gas leases with 130 more pending, and permits were issued for 8 oil and gas wells and 5 mineral-related activities. During 1984, financial returns to counties within the Hoosier National Forest totaled $218,965. Payments in lieu of taxes were $72,927. County revenue from timber sales and camping and mineral leases was $146,078.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Abrasives.**—*Manufactured.*—The Jumbo Manufacturing Inc. in Tippecanoe, Marshall County, manufactured chilled and annealed iron shot and grit. Sales increased 8% in quantity, while value remained essentially unchanged from 1983 levels. Jumbo Manufacturing also produced gray iron castings.

The steel shot and grit plant of Wheelabrator-Frye Inc. at Mishawaka in St. Joseph County, while maintaining manufacturing capabilities, remained idle throughout the year. All production was transferred to the company's Bedford, VA, plant when the Mishawaka plant was closed in 1983.

*Natural.*—Hindostan Whetstone Co. obtained siltstone from the Hopper Quarry, which operated on demand, at Orleans in Orange County. Product lines, in order of value, included sharpening stones, cuticle removers, and discs for table coasters. These special silica stone products were manufactured at its plant at Bedford in Lawrence County. The quantity of sales increased threefold, while value increased 117% over 1983 levels. Arkansas and Indiana are the only domestic producers of oilstones and whetstones.

**Cement.**—Three companies manufactured cement in the State—Lehigh Portland Cement Co., Lone Star Industries Inc., and Louisville Cement Co. Reflecting greater activity by the construction industry and an improvement of the U.S. economy, these companies posted increases in the value of sales of portland and masonry cement of 14.5% and 26%, respectively, over 1983 levels. At the same time, U.S. total value increased by 15% and 18%, respectively. Since the U.S. cement industry's disastrous 20-year low of 1982, the second largest gain in portland cement shipments was realized in 1984.

Ownership changes, generally international in scope, occurred during the year. In the largest takeover, Louisville Cement was purchased for $113 million by Coplay Cement Co., a subsidiary of Société des Ciments Français, headquartered in Paris, France. Louisville Cement produced both portland and masonry cement at Logansport in Cass County and at Speed in Clark County.

Lehigh, a subsidiary of Heidelberger Zement AG of the Federal Republic of Germany, produced calcium aluminate cement at its Buffington Station plant at Gary in Lake County and portland cement at its Mitchell plant in Lawrence County. The Buffington Station plant is one of only three in the Nation that produces nonportland hydraulic cement. Lehigh also operated a distribution terminal at Anderson in Madison County. Lone Star, by far the largest cement-producing company in the Nation, manufactured both portland and masonry cement at its Greencastle plant in Putnam County. Also, Moore McCormack Resources Inc. operated a cement distribution terminal in Cincinnati.

**Clays.**—Common clay and shale was produced by 11 companies at 14 operations in 10 of Indiana's 92 counties in 1984. Production, exclusive of fire clay, was 653,000 short tons valued at $2.1 million. Compared with 1983 levels, quantity and value increased 17% and 47%, respectively. This increase in output, for the second consecutive year, continued to reverse the downward trend in production that had persisted from 1978 to 1982. Of the total production of common clay and shale, 19% was used in the manufacture of face brick and 58% was used in the manufacture of portland cement. Other uses included lightweight aggregate, drain tile, pottery, and electrical porcelain.

**Table 4.—Indiana: Clays sold or used by producers**

(Thousand short tons and thousand dollars)

| Year | Fire clay | | Common clay and shale | | Total | |
|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value |
| 1980 | (1) | 3 | 932 | 1,927 | 932 | 1,930 |
| 1981 | -- | -- | 691 | 1,602 | 691 | 1,602 |
| 1982 | -- | -- | 501 | 1,221 | 501 | 1,221 |
| 1983 | (1) | W | 558 | 1,421 | 558 | 1,421 |
| 1984 | W | W | 653 | 2,085 | 653 | 2,085 |

W Withheld to avoid disclosing company proprietary data.

[1] Less than 1/2 unit.

There was also a 67% increase in production of fire clay as Yellow Banks Clay Products Inc. in Dubois County continued to expand its operations from hand-turned pottery to making fine-ground limestone and clay fillers. The company distributed its fillers to a wide Midwestern manufacturing market. The fire clay was used for animal feed, plastics, pottery, and rubber. At midyear, Yellow Banks was adding a warehouse and had ordered a new roller mill to increase plant capacity. The company also purchased a white limestone deposit near Leavenworth and installed a portable crusher.

Tecotta Industries Inc. acquired the former plant of Logan Clay Products Co. at Brazil in Clay County. The company planned to manufacture floor tile with purchased clays at the 600-ton-per-month-capacity plant.

**Gypsum.**—National Gypsum Co. and United States Gypsum Co. produced crude gypsum from underground mines at Shoals in Martin County. Both companies calcined gypsum for the manufacture of wallboard and associated products at minesite plants. U.S. Gypsum also operated a wallboard manufacturing facility at East Chicago in Lake County using rock from its quarry operation in Alabaster, MI.

Although mine production remained essentially unchanged from the high 1983 levels, the value of calcined gypsum production increased by 6.4%, since new residential construction was relatively strong. Also, even though housing starts failed to equal the prior peak levels of the 1978-79 period, industrial wallboard shipments exceeded those levels as usage increased in the commercial, industrial, and remodeling sectors.

U.S. Gypsum completed a Franklin Fiberim filler plant in East Chicago and began production. The plant has an 8-million-pound-per-year capacity. This gypsum-based fiber filler, when added to certain plastics, enhances tensile, impact, and flexural strength. Also, U.S. Gypsum's $50 million project to develop an underground mine and build a wallboard plant on a 120-acre site in La Porte County continued to encounter strong opposition throughout the year from homeowners living near the site. Industrial zoning had been approved by local governmental bodies, but the rezoning, residential to industrial, was being contested through the courts.

**Lime.**—Two Lake County companies produced quicklime during the year for steelmaking. Marblehead Lime Co. operated a plant for United States Steel Corp. (USS) at Buffington Station near Gary, and Inland Steel Co. operated a plant near its Indiana Harbor Works in East Chicago. Both operations received their limestone by lake freighter from captive quarries in Michigan. Although raw steel production in Indiana fell 2% in 1984, lime production increased 10%.

Leading quicklime-consuming States, in decreasing order of production, were Pennsylvania, Indiana, Ohio, and Michigan.

These four States, each of which consumed more than 1 million tons, accounted for 42% of total domestic quicklime consumption.

**Peat.**—In 1984, eight peat mining operations produced 51,000 tons of peat in Indiana. Sales of 61,000 tons were valued at $1.4 million. Compared with 1983 levels, production fell 22% while sales and value decreased 25% and 31%, respectively.

Nationally, the State ranked a distant third behind Florida and Michigan in sales of peat. Indiana's market share was 7.5%, whereas the two leaders' combined share was 60%. Indiana sales were used primarily for general soil improvement. Indiana peat was also used as an ingredient in potting soils and for nurseries and golf courses.

The Lake County Plan Commission granted a zone change from agricultural to conditional development to allow a peat mining business in Winfield to continue for another 20 years. The 38 acres used for peat mining by the Stutts brothers are on the family's 300-acre farm.

**Perlite (Expanded).**—Four companies operated perlite expansion plants in 1984—National Gypsum and U.S. Gypsum at Shoals in Martin County, Grefco Inc. at Crawfordsville in Montgomery County, and Chemrock Corp. at Lafayette in Tippecanoe County.

U.S. Gypsum's expanded perlite operation at its East Chicago facility was idle throughout the year. The U.S. Gypsum and National Gypsum plants at Shoals produced perlite plaster aggregate.

During the year, Grefco, a major producer and processor of perlite and diatomite, acquired Chemrock, a multiplant producer of expanded perlite products. The Indiana plants of Grefco and Chemrock produced filter aid. Chemrock also produced aggregates for concrete, plaster, and formed products; cavity-fill insulation; fillers; and horticultural aggregate. The Chemrock takeover should enable Grefco to market a full line of expanded perlite products in addition to its traditional role as a major domestic supplier of crude perlite ore. Chemrock was expected to continue to operate as a separate unit.

The 22,200 short tons of expanded perlite that were sold or used in Indiana were valued at $5 million. Although sales and value decreased by 9% and 5%, respectively, from 1983 levels, the average value per ton increased from $217 to $225—$53 over the national average.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

A total of 16.1 million short tons of construction sand and gravel valued at $44.7 million, f.o.b. plant or mine, was produced in Indiana in 1984, increases of 12% and 18%, respectively, over 1983 levels. Production, as reported to the U.S. Bureau of Mines, is the material that is actually sold or used; stockpiled material is not reported until it is sold or consumed. Value is also f.o.b., usually at the first point of sale or

**Table 5.—Indiana: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 2,988 | $9,135 | $3.06 |
| Plaster and gunite sands | 77 | 384 | 4.98 |
| Concrete products | 467 | 1,506 | 3.23 |
| Asphaltic concrete | 1,188 | 4,039 | 3.40 |
| Road base and coverings[1] | 1,079 | 3,188 | 2.96 |
| Fill | 1,131 | 2,446 | 2.16 |
| Snow and ice control | 208 | 566 | 2.72 |
| Railroad ballast | 9 | 46 | 5.20 |
| Other[2] | 8,925 | 23,434 | 2.63 |
| Total or average | [3]16,071 | 44,744 | 2.78 |

[1] Includes road and other stabilization (cement and lime).
[2] Includes other unspecified uses.
[3] Data do not add to total shown because of independent rounding.

captive use, and excludes transportation costs from the plant or mine to the consumer.

In 1984, production was reported from 132 operations including 113 with stationary and/or portable plants, 7 pit-run operations, and 12 dredging operations.

*Industrial.*—A total of 194,000 short tons of industrial sand valued at $1.1 million, f.o.b plant, was produced in Indiana in 1984.

In 1984, three companies reported industrial sand production in the State. Unimin Corp. at Michigan City in La Porte County produced primarily glass sand and some engine sand; Crisman Sand Co. Inc. at Portage in Porter County produced refractory sand; and Harrison Steel Castings Co. at Attica in Fountain County produced foundry sand for its railway steel castings.

**Slag—Iron and Steel.**—Three companies, Heckett Co. and Vulcan Materials Co. at East Chicago and The Levy Co. Inc. at Burns Harbor, processed slag for use by the construction industry. Levy and Vulcan Materials processed air-cooled iron slag. Heckett only produced steel slag from the basic oxygen process.

Air-cooled blast furnace (iron) slag was used mainly for road base, fill, and concrete and asphaltic concrete aggregates. Expanded blast furnace (iron) slag was used mainly as lightweight concrete aggregate. Steel slag was typically used as road base and fill. In 1984, sales and value of iron slag increased 24% and 53%, respectively, over 1983 levels. Sales of steel slag remained unchanged, but their value increased 17%. All but about 20% of steel slag was recycled to the blast furnace or used as construction aggregate.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—A total of 26.7 million tons of crushed stone, valued at $99.4 million, f.o.b. plant, was estimated to have been produced in Indiana in 1984, an increase of 11% over 1983 production. This tonnage was the sixth largest recorded this decade, yet output was 22% below that of 1979, the record high year.

The primary uses of crushed stone were for construction aggregates (45%); agricultural limestone (8%); cement, lime, and glass manufacture; flux stone; and other special uses such as sulfur dioxide removal. In the past 2 years, the State's construction aggregates industry made significant gains in both the quantity and value of production following 3 years of economic recession. Yet the combined output of construction aggregates in 1984 was only about 68% that of 1979, the record high year.

FMC Corp., the Electric Power Research Institute, and three midwestern utilities participated in a $2.1 million program to construct a demonstration plant of FMC's new limestone double-alkali process for flue gas desulfurization (FGD). The new system will reduce material cost, since limestone is about one-fourth the cost of lime. The pilot plant was constructed at Northern Indiana Public Service Co.'s Schahfer Station near Wheatfield in Jasper County. It was tied in with the station's newest unit, No. 17, rated at 400 megawatts. The pilot plant handled 9,000 cubic feet per minute of flue gas and 150 pounds per hour of sulfur dioxide. If successful in burning high-sulfur coal more economically while being environmentally acceptable, the station would need 160,000 tons of fine-grind limestone annually. According to a study conducted by the Illinois Department of Energy and Natural Resources and published in Illinois Mineral Notes 90, 1985, 1.2 million tons of lime and 2.0 million tons of pulverized limestone was used in 1984 for sulfur removal in FGD systems in the United States. Their linear regression analysis and mathematical model indicated that demand in 1992 could increase by approximately 9 million additional tons for lime and 21 million additional tons for limestone, but that the use of FGD alone probably would not achieve the required lowering in sulfur dioxide emissions.

Rogers Group Inc. announced in October that it was divesting itself of asphalt and light-construction operations in Indiana and shifting its primary emphasis to coal mining. The company plans to continue to operate its 13 Indiana aggregates plants.

Irving Materials Inc., Greenfield, acquired Ready Mix Corp. of Lafayette and its subsidiary, Crawfordsville Ready Mix. Irving Materials was a supplier of concrete and aggregates to central Indiana, operating 15 concrete plants, 6 sand and gravel pits, and 2 limestone quarries. The purchase, expanding its marketing area to 25 counties in the region, made Irving Materials the largest concrete company in central Indiana.

In September, the new plant at the Pipe

Creek Jr. quarry in Grant County was producing pulverized limestone from high-calcium reefal limestone. The products, in three grain sizes from the No. 8 to the No. 200-sieve size, were used as feed supplements for poultry and cattle. By October, the company was selling all the product that it was crushing, and the plant had yet to reach capacity production. The company, Calcium Products Inc., was owned by The France Stone Co. and Pipe Creek Jr.

*Dimension.*—1984 was another good year in the building stone industry of Indiana. A total of 2.07 million cubic feet of dimension stone, valued at $14.3 million f.o.b. plant, was estimated to have been produced. The 585,000-cubic-foot increase in quantity and the $3.3 million increase in value represented 10% and 30% gains, respectively, over 1983 levels.

The State's limestone industry has been operating near 100% of plant capacity in the past few years, and the outlook for the next few years was good, although the industry has made many investments in plant and equipment with subsequent increased capacity. The reasons for this are twofold—a unified promotion by the industry's trade association, Indiana Limestone Institute of America Inc.; and a rather unique material, the Salem Limestone, that has lower production unit costs compared to marble or granite. These conditions should tend to reduce import competition.

Overall, however, for all types of dimension stone, except limestone, domestic producers lost ground to imports in 1984. Over 98% of Indiana's production was limestone, primarily from the Bloomington-Bedford District of southern Indiana. The remainder was sandstone from Brown County.

**Sulfur (Recovered).**—Amoco Oil Co. recovered elemental sulfur from refinery gases at its petroleum refinery at Whiting in Lake County. Production increased 22% over the 1983 level, while shipments and value increased 20% and 34%, respectively.

Stauffer Chemical Co. produced sulfuric acid, liquid sulfur dioxide, and liquid sulfur trioxide at its Hammond plant in Lake County. Stauffer Chemical, along with ASARCO Incorporated and Tennessee Chemical Co., were the three largest producers of sulfur dioxide.

## METALS

**Aluminum.**—Aluminum Co. of America (Alcoa), the State's sole producer of this primary metal, operated a smelter and fabrication plant in Warrick County near Evansville in southwestern Indiana. The Warrick Operations consisted of smelting, recycling, ingot casting, and fabrication facilities. The fully integrated facility produced light-gauge aluminum sheet for beverage cans, which was Alcoa's largest single product. Coincident with Alcoa's reported 18% increase in revenues over 1983 in the packaging and container segment, the value of production at its Warrick facility increased about 18% on a modest 2.5% increase in production. Demand for aluminum can was up because of an improved U.S. economy and the recyclability of aluminum cans. In 1984, 58% of Alcoa's rigid container (can) body sheet was produced from recycled aluminum beverage cans, up from 14% in 1974.

The $54 million installation of an electromagnetic casting (EMC) unit at Warrick was on schedule for an early 1986 completion. EMC provides superior ingot for rolling. Also, an extensive $120 million, 2-year modernization of the rolling mill facility was begun. Two hot rolling mills and one of four cold rolling mills would be made wider. The Warrick Operations received the U.S. Senate's first Productivity Award, which recognized quality and productivity efforts. Alcoa also operated finishing mills at Fort Wayne, Lafayette, and Richmond and had research facilities at Fort Wayne and Richmond.

Aluminum Co. of Canada Ltd. (Alcan) expected to complete acquisition of certain aluminum assets of Atlantic Richfield Co.'s (ARCO) aluminum business in January 1985, following court approval of a consent decree entered into in late 1984 between the U.S. Justice Department, Alcan, and ARCO. ARCO's 35,000-ton-per-year rolling mill at Terre Haute was among the assets involved.

In May, WheelTek opened its new cast aluminum wheel plant at Fremont in Steuben County. The plant's opening capacity was 600,000 wheels. WheelTek was a 50-50 joint venture of Amcast Industrial Corp., Dayton, OH, and Dynamark Inc., Brea, CA. Later in the year, the company announced a $3.5 million expansion to increase capacity to 1 million wheels annually to serve General Motors Corp., WheelTek's biggest customer, Ford Motor Co., and Chrysler Corp. The plant was built within 2 hours of a General Motors assembly plant, making it possible for twice daily deliveries.

**Copper and Copper Alloys.**—*Beryllium-Copper.*—At midyear, Cabot Wrought Products Div. of the Boston, MA-based Cabot

Corp. opened its $16 million, wide-strip, beryllium-copper processing mill in Elkhart. The new mill rolled in widths up to 50 inches and at speeds to 1,000 feet per minute. Its annual processing capacity is 42 million pounds. Unique to the facility, which incorporated the latest advances in dimensional control and high-speed metal processing, were special bell furnaces designed for homogenization of hot band feedstock and mill hardening of the finished metal. The plant was expected to employ 125 persons when fully operational. Feedstock for the Elkhart plant was produced at Cabot's new $52 million, hot rolling mill at its Kokomo plant. Beryllium copper was used extensively in electrical components in computers, telecommunications, and other electronic products.

*Brass.*—Bridgeport Brass Co., Indianapolis, was renamed the Bridgeport Brass Corp. following completion in August of the sale of the plant and its assets by National Distillers & Chemical Corp. to a private investor. The brass mill, which was over a century old, employed about 950 workers. It had an annual capacity of 200,000 pounds and had produced primarily one product, plain yellow strip. Under the new ownership, plans were to expand the plant's mill capabilities to include the production of other alloys and lighter gauges. Also, a letter of intent was signed in November for the new owner to purchase National Distillers' stamping plant in Mitchell, IN. The stamping plant would primarily use strip supplied from the Indianapolis mill.

Bridgeport Brass was awarded a contract by the U.S. Mint for the rolling of all the cupronickel coin strip that the mint would use during the first 6 months of 1985.

*Copper (Fabricated).*—With 10,000 copper fabricating jobs in the Fort Wayne area and another 8,000 across the State, the President's decision against granting protective quotas and tariffs on imported refined copper was well received in Indiana. In January, 11 copper-producing companies, citing injury caused by copper imports, asked the International Trade Commission (ITC) to limit imports.

Following the unanimous decision by the ITC supporting the copper-producing companies and the split ITC recommendation to the President for imposition of import tariffs or quotas, fabricators registered their further objections, contending that import restrictions, by requiring domestic fabricators to pay a high price for refined copper, would give foreign fabricators a competitive edge.

**Iron and Steel.**—Although U.S. steel production and shipments continued to recover from the very low levels of 1982, Indiana's steelmakers missed out on the economic recovery of 1984. The State's share of total domestic pig iron and raw steel production in 1984 was 30.5% and 21.4%, respectively, and Indiana continued to be the top U.S. steelmaker.

Indiana's pig iron production and value of shipments from furnaces in 1984 were 15.9 million tons and $2.9 billion, respectively, down 3% and 12% from 1983 levels, whereas U.S. production and value increased by 6.3% and a very modest 1.2%. Raw steel production in Indiana at 19.8 million tons was down 2% from that of 1983, whereas total U.S. production was 9.3% higher than that of 1983.

Bethlehem Steel Corp. began construction of its $200 million, No. 2 continuous slab caster at Burns Harbor. This caster and another being constructed at Sparrows Point, MD, would add 5.1 million tons of annual capacity and give Bethlehem the ability to continuously cast 90% of its production. These casters were planned to start up in 1986. Also at Burns Harbor, in response to the automobile industry's need for better corrosion-resistant sheet, Bethlehem was converting its shutdown tin plate line to a 100,000-ton-per-year electrogalvanizing line to begin operation in 1985.

Also, Bethlehem began working with the U.S. Department of Energy in a $30 million program to develop new technology for achieving a major breakthrough in the continuous casting of steel directly from the furnace. The project would produce much thinner steel slabs than is now possible. In another cooperative agreement, Bethlehem and Inland Steel agreed to build a new electrogalvanizing line. Although joint ventures had been suggested as a way to help the domestic steel industries meet foreign competition, this particular arrangement posed a special antitrust problem, because Bethlehem had a new $60 million continuous sheet steel, heat-treating line at Burns Harbor, and a similar facility, costing $100 million, recently went into production at the Indiana Harbor Works of Inland Steel in East Chicago. Bethlehem and Inland Steel were the first in the domestic steel industry to produce deep-drawing and high-strength sheet steel, the types of products that would greatly benefit from electrogalvanizing.

Inland Steel at Indiana Harbor began preliminary engineering for a $250 million, "state-of-the-art" steel mill to process 1 million tons per year of sheet for the automotive, appliance, and office furniture markets.

Continental Steel Corp., Kokomo, ordered a $21 million, eight-strand continuous billet caster to be installed by the second quarter of 1985. In April, a month ahead of schedule, the company's $18.3 million twin-strand rod mill went into operation. Continental has more than tripled its capacity for outside sales of wire rod. Further expansion of capacity to nearly 350,000 tons annually from a new level of nearly 150,000 tons could be made with modifications of facilities now in place.

LTV Steel Co.'s East Chicago plant started up its two parallel continuous slab casters in November 1983. The $165 million installation was operating at full-capacity production of 265,000 slab tons per month in late 1984.

Jones & Laughlin Steel Corp. (J&L), a subsidiary of LTV Corp., and Republic Steel Corp. merged to form the LTV Steel Co. after overcoming antitrust objections from the U.S. Department of Justice. The new LTV Steel became the second largest domestic steel producer, after USS. At the time of the merger, J&L and Republic had a combined raw steel capability of over 24 million tons annually, about one-sixth of the U.S. total. In another situation, antitrust objections were not overcome, and the USS proposal to acquire the National Steel Corp. subsidiary of National Intergroup Inc. was canceled. Later, however, National Intergroup sold a 50% interest in National Steel to Nippon Kokan K.K., Japan's fourth largest steel company. In the newly formed joint venture, Nippon Kokan acquired one-half interest in National Steel's three steel plants—Escorse, MI, Portage, IN, and Granite City, IL. A pilot electrogalvanizing line slated for Portage was planned.

The September 10 decision of the U.S. Environmental Protection Agency to regulate coke oven emissions was expected to have a serious impact on all four of Indiana's large steelmakers. USS in Gary, Bethlehem at Burns Harbor, and Inland Steel and LTV Steel in East Chicago operated coke oven steel plants, and all were within 30 miles of Chicago.

**Titanium.**—Cabot moved out of the titanium flat-rolled product business after failing to develop its titanium sponge and ingot production capabilities in the United States. The decision to withdraw from the market came 2 years after the company began producing titanium flat-rolled products, primarily in unalloyed form for industrial use, at its Kokomo mill.

**Table 6.—Principal producers**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Abrasives: | | | |
| Manufactured: | | | |
| Jumbo Manufacturing Inc | Box 155, 2900 Center St.<br>Tippecanoe, IN 46570 | Plant | Marshall. |
| Wheelabrator-Frye Inc., Materials Cleaning Systems Div.[1] | 400 South Byrkit St.<br>Mishawaka, IN 46544 | do | St. Joseph. |
| Natural: | | | |
| Hindostan Whetstone Co | Box 862<br>2828 Garvey Lane<br>Bedford, IN 47421 | Quarry and plant | Orange (quarry) and Lawrence (plant). |
| Aluminum: | | | |
| Aluminum Co. of America | Warrick Operations<br>Box 10<br>Newburgh, IN 47630 | Smelter and fabricating plant. | Warrick. |
| Cement: | | | |
| Lehigh Portland Cement Co.[2] | Box 97<br>Mitchell, IN 47446 | Plant (portland) and quarry. | Lawrence. |
| Do | Buffington Station<br>Gary, IN 46401 | Plant (calcium aluminate). | Lake. |
| Do | 6300 Columbus Ave.<br>Anderson, IN 46013 | Terminal (distribution). | Madison. |
| Lone Star Industries Inc.[2] [3] | Box 482<br>Greencastle, IN 46135 | Plant (portland masonry) and quarry. | Putnam. |
| Louisville Cement Co.[2] [3] [4] | Box 659, Highway 25 West<br>Logansport, IN 46947 | Plant (portland) and quarry. | Cass. |
| Do | Speed, IN 47172 | Plant (portland masonry) and quarry. | Clark. |

See footnotes at end of table.

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[1]State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

## Table 6.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays: | | | |
| General Shale Products Corp | Box 96<br>Mooresville, IN 46158 | Pits and plant | Morgan. |
| Hydraulic-Press Brick Co | Brooklyn, IN 46111 | Pit and plant (lightweight aggregate). | Do. |
| Gypsum: | | | |
| National Gypsum Co.[5] | Box 250<br>Shoals, IN 47581 | Underground mine and plant. | Martin. |
| United States Gypsum Co.[5] | Box 298<br>Shoals, IN 47581 | do | Do. |
| Do | 3501 Canal St.<br>East Chicago, IN 46312 | Plant | Lake. |
| Iron and steel: | | | |
| Bethlehem Steel Corp | Box 248, U.S. 12<br>Chesterton, IN 46304 | Mill (integrated) | Porter. |
| Continental Steel Corp | 1111 South Main St.<br>Box 5049<br>Kokomo, IN 46902 | Minimill | Howard. |
| Inland Steel Co | 3210 Watling St.<br>East Chicago, IN 46312 | do | Lake. |
| LTV Steel Co.[6] | 3001 Dickey Rd.<br>East Chicago, IN 46312 | Mill (integrated-finishing) | Do. |
| National Steel Corp., Midwest Steel Div. | U.S. 12<br>Portage, IN 46368 | Mill (rolling) | Porter. |
| United States Steel Corp., Gary Works Div. | 1 North Broadway<br>Gary, IN 46402 | Mill (integrated) | Lake. |
| Lime: | | | |
| Inland Steel Co., Indiana Harbor Works. | 3210 Watling St.<br>East Chicago, IN 46312 | Plant | Do. |
| Marblehead Lime Co | Box 689<br>Gary, IN 46402 | do | Do. |
| Peat: | | | |
| Hyponex Corp., Noblesville plant. | 2013 South Anthony Blvd.<br>Fort Wayne, IN 46803 | Bog and plant | Hamilton. |
| Michigan Peat Co | Box 234, Rural Route 6<br>Rensselaer, IN 47978 | do | Jasper. |
| Milburn Peat Co. Inc | Box 236<br>La Porte, IN 46350 | do | La Porte. |
| Perlite (expanded): | | | |
| Chemrock Corp.[7] | Box 5465, Highway 25 at Monon RR Crossing<br>Lafayette, IN 47903 | Plant | Tippecanoe. |
| Grefco Inc | Box 48, 100 East Country Rd.<br>Crawfordsville, IN 47933 | do | Montgomery. |
| Sand and gravel: | | | |
| Construction: | | | |
| American Aggregates Corp | District Office<br>Box 40228<br>4700 East 96th St. and Gray Rd.<br>Indianapolis, IN 46240<br>Corporate Headquarters<br>Drawer 160<br>Garst Ave. at Ave. B<br>Greenville, OH 45331 | Pits and plants | Hamilton,<br>Marion,<br>Wayne. |
| Hilltop Basic Resources Inc | 630 Vine St.<br>Cincinnati, OH 45202 | Pit and plant | Switzerland. |
| Irving Materials Inc | Box 369, Rural Route 5<br>Greenfield, IN 46140 | Pits and plants | Fayette,<br>Hamilton,<br>Henry,<br>Madison,<br>Wayne. |
| Martin Marietta Aggregates | Box 30013, 2170 Wycliff Rd.<br>Raleigh, NC 27622 | do | Clark,<br>Hamilton,<br>Howard,<br>Marion,<br>Vermillion,<br>Vigo. |
| Rogers Group Inc | Box 849, 350 South Adams St.<br>Bloomington, IN 47402 | do | Fountain,<br>Gibson,<br>Greene,<br>Knox,<br>Morgan,<br>Owen,<br>Warren. |
| Vulcan Materials Co.[2,8] | Box 5529<br>Lafayette IN 47903 | do | La Porte,<br>Parke,<br>St. Joseph,<br>Tippecanoe. |
| Industrial: | | | |
| Crisman Sand Co. Inc | 6480 Melton Rd.<br>Portage, IN 46368 | Pit and plant | Porter. |
| Unimin Corp | 258 Elm St.<br>New Canaan, CT 06840 | do | La Porte. |

See footnotes at end of table.

## Table 6.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Slag: | | | |
| Iron: | | | |
| Vulcan Materials Co.[2,9] | Box 6, 500 West Plainfield Rd.<br>Countryside, IL 60525 | Plant | Lake. |
| Iron and steel: | | | |
| The Levy Co. Inc.[2,9] | Box 540<br>Portage, IN 46368 | Plants | Lake, Porter, St. Joseph. |
| Steel: | | | |
| Heckett Co | Box 1071, North Main St.<br>Butler, PA 46368 | Plant | Lake. |
| Stone: | | | |
| Crushed: | | | |
| American Aggregates Corp | District Office<br>Box 40228<br>4700 East 96th St. and Gray Rd.<br>Indianapolis, IN 46240<br>Corporate Headquarters<br>Drawer 160<br>Garst Ave. at Ave. B<br>Greenville, OH 45331 | Quarries and plants | Hamilton,<br>Marion,<br>Owen. |
| The France Stone Co | Box 1928<br>Toledo, OH 43603 | do | Allen and Putnam. |
| Irving Materials Inc.[9] | Rural Route 13<br>Box 300<br>Muncie, IN 47302 | do | Blackford,<br>Delaware,<br>Grant,<br>Huntington,<br>Madison,<br>Wells. |
| Martin Marietta Aggregates, Central Div. | Box 30013, 2170 Wycliff Rd.<br>Raleigh, NC 27622 | do | Clark,<br>Hamilton,<br>Howard,<br>Madison,<br>Marion. |
| Mulzer Crushed Stone Co | Box 248, 603 6th St.<br>Tell City, IN 47586 | Quarries, mine, plants. | Crawford and Perry. |
| Rogers Group Inc.[3] | Box 849, 350 South Adams St.<br>Bloomington, IN 47402 | Quarry and plants | Lawrence,<br>Monroe,<br>Newton,<br>Putnam. |
| Dimension: | | | |
| Bybee Stone Co | Box 968<br>Bloomington, IN 47402 | Quarry and plant | Monroe. |
| Elliot Stone Co. Inc | Box 743<br>Bedford, IN 47421 | Quarries and plant | Lawrence. |
| Evans Quarries Inc | Box 711<br>Bedford, IN 47421 | Quarry and plant | Do. |
| B. G. Hoadley Co. Inc | Box 1224<br>Bloomington, IN 47402 | Quarry and plants | Lawrence and Monroe. |
| Independent Limestone Co | 6001 South Rockport Rd.<br>Bloomington, IN 47401 | Quarry and plant | Monroe. |
| Indiana Limestone Co. Inc | Box 72, 405 I St.<br>Bedford, IN 47421 | Quarries and plants | Lawrence and Monroe. |
| Indiana Sandstone Co. Inc | Box 501<br>Bedford, IN 47421 | Quarry and plant | Lawrence. |
| Reed Quarries Inc | Box 64<br>Bloomington, IN 47402 | do | Monroe. |
| Rush County Stone Co. Inc.[2] | Rural Route 1<br>Box 20A<br>Milroy, IN 46156 | do | Rush. |
| Victor Oolitic Stone Co | Box 668<br>Bloomington, IN 47402 | do | Monroe. |
| Sulfur (recovered): | | | |
| Amoco Oil Co | Box 710<br>2815 Indianapolis Blvd.<br>Whiting, IN 46394 | Refinery | Lake. |

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[1] Idle throughout 1983 and 1984.
[2] Also crushed stone.
[3] Also clays.
[4] Acquired by Coplay Cement Co., Nazareth, PA, a subsidiary of Société des Ciments Français, Paris, France.
[5] Also expanded perlite.
[6] Formed in June by the merger of Jones & Laughlin Steel Corp. and Republic Steel Corp.
[7] Chemrock Corp. (Nashville, TN) was acquired by Grefco Inc. (Los Angeles, CA).
[8] Also iron slag.
[9] Also construction sand and gravel.

# The Mineral Industry of Iowa

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Iowa Geological Survey for collecting information on all nonfuel minerals.**

## By James H. Aase[1] and Wanda J. West[2]

The value of nonfuel mineral preduction in Iowa during 1984 rose slightly over that of 1983 and was above the 10-year average.

Nationally, Iowa ranked 29th in value of nonfuel mineral production, accounting for 1% of the U.S. total. Three of the nine mineral commodities produced in the State during 1984 recorded increases in value and five had production gains over those of 1983.

Crushed stone, the leading commodity produced in the State in terms of value, accounted for over one-third of every dollar of the State's total mineral value during 1984. Cement ranked second in value, followed by construction sand and gravel, together accounting for over one-half of the State total.

Among the minerals produced in 1984, the quantity of gypsum produced in Iowa ranked 4th among 22 producing States; peat 12th of 22; portland cement, 15th of 40; crushed stone, 17th of 48; construction sand and gravel, 20th of 50; clays, 21st of 44; and lime, 25th of 38.

Dexter Co. of Fairfield announced a $2.2 million plant expansion at its foundry operations. Central to the expansion plan was the installation of a highly automated molding machine that would permit the company to enter the high-volume casting market.

In 1984, the State issued no permits for metallic mineral exploration.

**Employment.**—The Iowa Employment Security Commission's statistical data indicated that, at midyear, employment in the mining industry was 2,300 compared with 2,000 for the same period in 1983. The average hourly earnings of mining produc-

**Table 1.—Nonfuel mineral production in Iowa[1]**

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Cement: | | | | |
| Masonry ---- thousand short tons | 37 | $3,425 | 42 | $3,260 |
| Portland ---- do | 1,644 | 87,836 | 1,730 | 92,699 |
| Clays ---- do | 576 | 3,258 | 623 | 2,695 |
| Gem stones | NA | 1 | NA | W |
| Gypsum ---- thousand short tons | 1,612 | 13,518 | 1,527 | 12,421 |
| Peat ---- do | W | W | 11 | 400 |
| Sand and gravel (construction) ---- do | $^{e}$11,800 | $^{e}$32,800 | 13,882 | 37,027 |
| Stone (crushed) ---- do | 24,844 | 101,097 | $^{e}$23,800 | $^{e}$100,000 |
| Combined value of lime, stone (dimension, 1983), and values indicated by symbol W | XX | 5,425 | XX | 4,943 |
| Total | XX | 247,360 | XX | 253,445 |

$^{e}$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Iowa, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adair | (2) | W | Stone (crushed). |
| Adams | (2) | W | Do. |
| Allamakee | $76 | W | Do. |
| Appanoose | W | W | Stone (crushed), clays. |
| Audubon | W | (3) | |
| Benton | W | W | Stone (crushed). |
| Black Hawk | 964 | W | Do. |
| Boone | 1,644 | (3) | |
| Bremer | (2) | W | Stone (crushed). |
| Buchanan | W | $1,303 | Do. |
| Buena Vista | W | (3) | |
| Butler | W | W | Stone (crushed). |
| Calhoun | 70 | (3) | |
| Carroll | 397 | (3) | |
| Cass | W | W | Stone (crushed). |
| Cedar | W | 766 | Do. |
| Cerro Gordo | W | W | Cement, stone (crushed), clays. |
| Cherokee | 398 | (3) | |
| Chickasaw | (2) | 519 | Stone (crushed). |
| Clarke | (2) | W | Do. |
| Clay | 342 | (3) | |
| Clayton | W | 967 | Stone (crushed). |
| Clinton | W | 959 | Do. |
| Dallas | W | W | Clays. |
| Davis | (2) | W | Stone (crushed). |
| Decatur | (2) | W | Do. |
| Delaware | W | 688 | Do. |
| Des Moines | W | W | Gypsum, stone (crushed). |
| Dickinson | 382 | (3) | |
| Dubuque | (2) | W | Stone (crushed), stone (dimension). |
| Emmet | W | (3) | |
| Fayette | W | W | Stone (crushed). |
| Floyd | 81 | W | Do. |
| Franklin | 172 | W | Do. |
| Fremont | (2) | 632 | Do. |
| Greene | 524 | (3) | |
| Guthrie | 210 | (3) | |
| Hamilton | W | 388 | Stone (crushed). |
| Hancock | W | W | Do. |
| Hardin | W | 7,888 | Do. |
| Harrison | (2) | 1,604 | Do. |
| Henry | (2) | W | Do. |
| Howard | 45 | 801 | Do. |
| Humboldt | W | 1,186 | Do. |
| Ida | W | (3) | |
| Iowa | W | (3) | |
| Jackson | W | 1,111 | Stone (crushed). |
| Jasper | W | 337 | Do. |
| Jefferson | (2) | 82 | Do. |
| Johnson | W | W | Do. |
| Jones | 465 | 1,360 | Stone (crushed), stone (dimension). |
| Keokuk | W | 1,389 | Stone (crushed). |
| Kossuth | 97 | (3) | |
| Lee | 175 | 951 | Stone (crushed). |
| Linn | 958 | 3,974 | Stone (crushed), peat. |
| Louisa | W | W | Stone (crushed). |
| Lyon | 290 | (3) | |
| Madison | W | W | Stone (crushed), clays. |
| Mahaska | (2) | W | Stone (crushed). |
| Marion | W | W | Stone (crushed), gypsum. |
| Marshall | 557 | W | Stone (crushed). |
| Mills | (2) | 46 | Do. |
| Mitchell | W | W | Do. |
| Monona | W | (3) | |
| Monroe | (2) | 940 | Stone (crushed). |
| Montgomery | (2) | 874 | Do. |
| Muscatine | 479 | 1,767 | Do. |
| O'Brien | W | (3) | |
| Osceola | 304 | (3) | |
| Page | W | 508 | Stone (crushed). |
| Palo Alto | W | (3) | |
| Plymouth | 1,350 | (3) | |
| Pocahontas | (2) | W | Stone (crushed). |
| Polk | W | W | Cement, stone (crushed). |
| Pottawattamie | W | W | Stone (crushed). |
| Poweshiek | (2) | W | Do. |
| Sac | 1,196 | (3) | |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Iowa, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Scott | W | W | Cement, stone (crushed), lime, clays. |
| Shelby | W | (3) | |
| Sioux | $667 | (3) | |
| Story | W | W | Stone (crushed). |
| Tama | W | W | Do. |
| Taylor | (2) | $238 | Do. |
| Union | (2) | W | Do. |
| Van Buren | W | 1,620 | Do. |
| Wapello | W | W | Stone (crushed), clays. |
| Washington | W | W | Stone (crushed). |
| Webster | 8,810 | W | Gypsum, stone (crushed). |
| Winnebago | W | W | Peat. |
| Winneshiek | 174 | 1,045 | Stone (crushed). |
| Woodbury | W | W | Clays. |
| Worth | W | W | Stone (crushed), peat. |
| Wright | W | (3) | |
| Undistributed[4] | [r]108,781 | 180,614 | |
| Sand and gravel (construction) | XX | [e]32,800 | |
| Stone (crushed) | [e]88,800 | XX | |
| Total[5] | [r]218,409 | 247,360 | |

[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed stone was produced; data not available by county. Total State value is shown separately under "Stone (crushed)."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones and stone (dimension, 1982) that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Iowa business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 2,906 | 2,904 | 2,910 |
| Total civilian labor force | do. | 1,418 | 1,421 | 1,417 |
| Unemployment | do. | 121 | 116 | 100 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do. | 1.7 | 1.9 | 2.0 |
| Nonmetallic minerals except fuels[2] | do. | 1.6 | 1.7 | NA |
| Coal mining[2] | do. | .1 | .1 | NA |
| Manufacturing total | do. | 209.8 | 202.3 | 210.9 |
| Primary metal industries | do. | 7.9 | 7.1 | 8.0 |
| Stone, clay, and glass products | do. | 4.9 | 4.9 | 4.4 |
| Chemicals and allied products | do. | 6.9 | 6.6 | 6.7 |
| Petroleum and coal products[2] | do. | .2 | .2 | NA |
| Construction | do. | 38.1 | 35.9 | 37.1 |
| Transportation and public utilities | do. | 52.7 | 51.3 | 50.7 |
| Wholesale and retail trade | do. | 267.2 | 268.7 | 270.5 |
| Finance, insurance, real estate | do. | 58.9 | 59.8 | 61.5 |
| Services | do. | 211.4 | 217.1 | 224.6 |
| Government and government enterprises | do. | 202.0 | 203.4 | 205.1 |
| Total | do. | [3]1,041.9 | 1,040.4 | 1,062.4 |
| Personal income: | | | | |
| Total | millions | $30,949 | $30,733 | $35,382 |
| Per capita | | $10,650 | $10,584 | $12,160 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.7 | 39.8 | 40.2 |
| Mining | | 48.2 | 45.8 | 46.2 |
| Total average hourly earnings, production workers | | $10.01 | $10.09 | $10.25 |
| Mining | | $8.04 | $7.58 | $7.98 |

See footnotes at end of table.

Table 3.—Indicators of Iowa business activity —Continued

| | | 1982^r | 1983 | 1984^p |
|---|---|---|---|---|
| Earnings by industry: | | | | |
| Farm income | millions | $1,301 | $185 | $2,462 |
| Nonfarm | do | $18,906 | $19,603 | $21,039 |
| Mining total | do | $41 | $41 | $49 |
| Nonmetallic minerals except fuels | do | $33 | $37 | $42 |
| Coal mining | do | $5 | $3 | $4 |
| Manufacturing total | do | $5,141 | $5,167 | $5,578 |
| Primary metal industries | do | $246 | $246 | $288 |
| Stone, clay, and glass products | do | $116 | $122 | $123 |
| Chemicals and allied products | do | $187 | $188 | $199 |
| Petroleum and coal products | do | $6 | $6 | $6 |
| Construction | do | $957 | $949 | $1,067 |
| Transportation and public utilities | do | $1,474 | $1,506 | $1,570 |
| Wholesale and retail trade | do | $3,568 | $3,651 | $3,916 |
| Finance, insurance, real estate | do | $1,154 | $1,276 | $1,384 |
| Services | do | $3,417 | $3,671 | $3,992 |
| Government and government enterprises | do | $3,066 | $3,250 | $3,384 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 5,416 | 7,169 | 6,811 |
| Value of nonresidential construction | millions | $322.8 | $348.3 | $359.3 |
| Value of State road contract awards | do | $190.0 | $264.6 | $233.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 1,170 | 1,159 | 1,218 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $218.4 | $247.4 | $253.4 |
| Value per capita | | $75 | $85 | $87 |

^p Preliminary. ^r Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

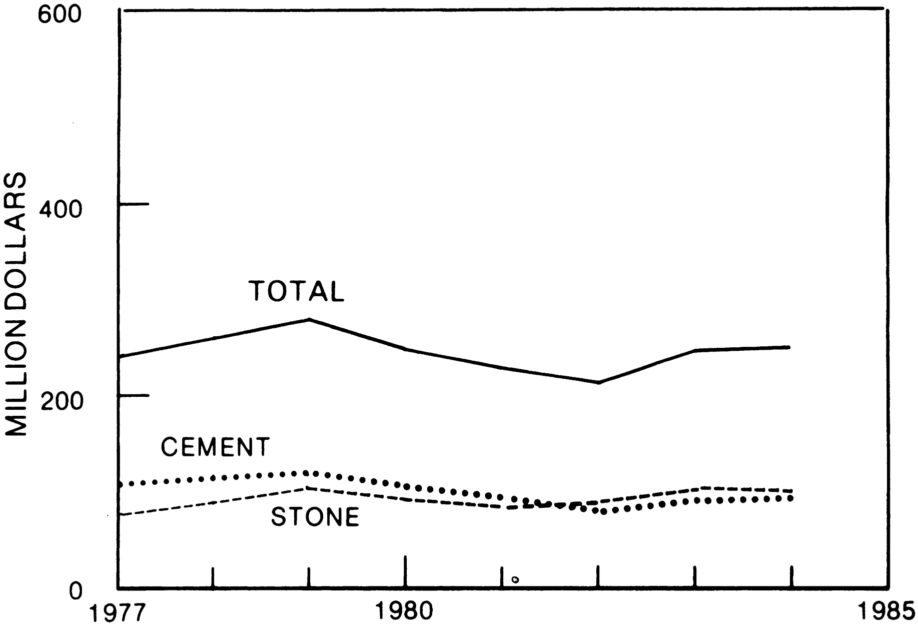

Figure 1.—Value of cement, stone, and total value of nonfuel mineral production in Iowa.

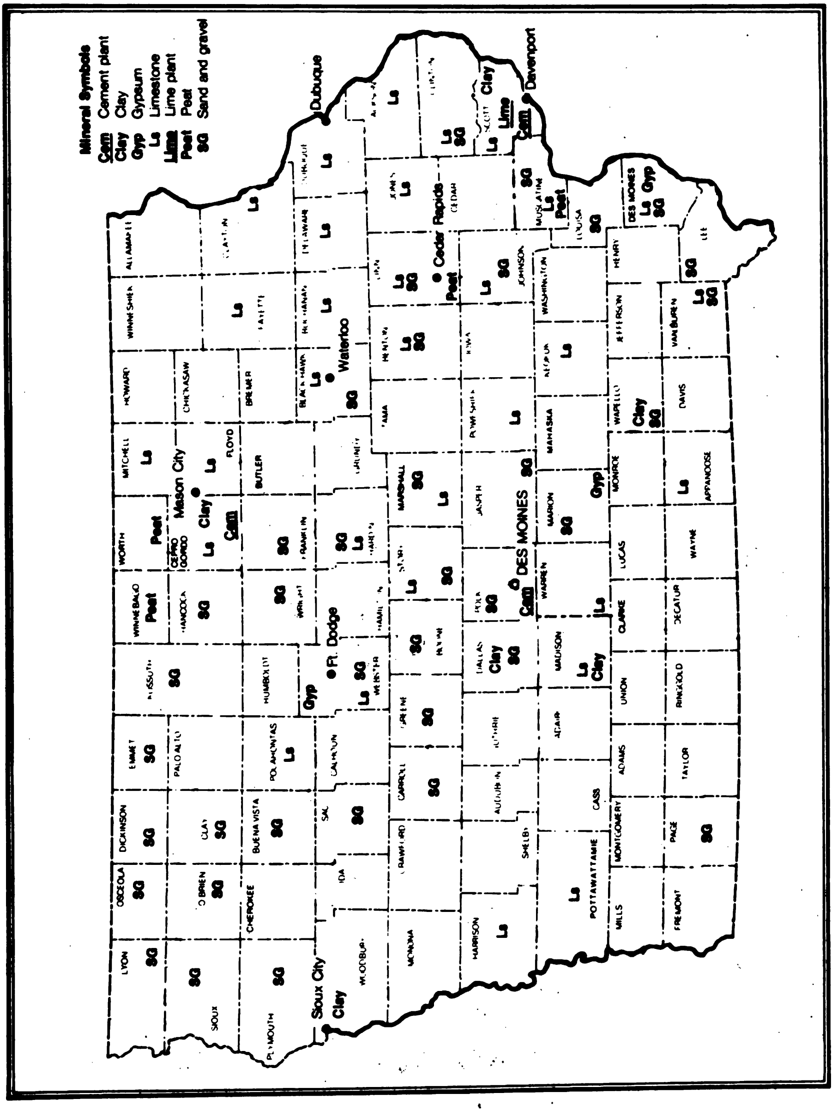

Figure 2.—Principal mineral producing localities in Iowa.

tion and related nonsupervisory workers was $7.88 in July 1984, an increase of approximately 5% compared with that of July 1983.

**Legislation and Government Programs.**—During fiscal year 1984, the State of Iowa received $122,615 from the U.S. Department of the Interior as compensation for the loss of revenue caused by the presence of certain tax-exempt Federal lands within its boundaries. The funding, commonly referred to as "payments in lieu of taxes," was based on a formula approved by Congress in a 1976 law.

The Mining and Mineral Resources Research Institute at Iowa State University, Ames, was awarded a grant by the U.S. Bureau of Mines in fiscal year 1984. The grant, made under authority of title III of the Surface Mining Control and Reclamation Act of 1977, Public Law 95-87, was to assist in the institute's operation and research designed to encourage the training of engineers and scientists in mineral-related disciplines.

In 1984, the U.S. Geological Survey completed a program of mapping the entire State on 7.5-minute series topographic maps. Each of the 1,083 maps covered an area about 9 miles by 6.5 miles and was at a scale of 1:24,000. They were the most accurate and detailed maps available of the State's land surface.

The Iowa Geological Survey (IGS), a permanently established State public service agency since 1892, continued surveying the economic and scientific aspects of the State's mineral resources. During 1984, IGS collected, managed, interpreted, and reported geologic and hydrologic data so that pertinent information would be available when it is needed for a variety of environmental and resource issues.

Studies conducted by IGS researchers over the past several years, in cooperation with various State and Federal programs, have concluded that contamination of ground water is widespread in Iowa, especially in bedrock carbonate aquifers and alluvial aquifers, and is caused by nonpoint, agricultural chemical losses. Increased nitrogen fertilization has resulted in ground water nitrate concentrations commonly rising to values above accepted health standards.

IGS reported that interest in the Midcontinent Gravity Anomaly as a target for oil and gas exploration was growing. An estimated 3 million acres in Iowa was under lease, and approximately 1,000 miles of seismic lines had been obtained as of 1984.

During 1984, IGS reported that its on-line computerized geological information retrieval system, GEO, was improved to handle water quality and well construction records. As of yearend, there were 11,200 sites included with geologic records. Of these, 3,300 included water quality information, and 5,300 contained well construction information.

IGS's library of rock cuttings (35,000 wells) and rock cores (800 sites) was completely inventoried and reorganized to make the samples more readily available for researchers and other users.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Cement.**—The cement industry in Iowa operated at approximately 59% of its clinker production and finish grinding capacity during 1984. Output during the year was from four companies that collectively operated eight kilns at one wet-process and three dry-process plants at sites in Cerro Gordo, Polk, and Scott Counties. All plants produced gray portland cement, and three produced masonry cement also. Raw materials consumed by the State plants in the cement manufacturing process during 1984 exceeded 3.1 million short tons, including 2.5 million tons of limestone, along with lesser amounts of anhydrite, bauxite, clays, fly ash, gypsum, iron ore, sand, shale, and other materials.

The quantity and value of Iowa's cement shipments in 1984 rose approximately 5% over those in 1983. The average value of portland cement sold by Iowa producers in 1984 was $53.58 per ton, approximately the same as in 1983; however, masonry cement's average value dropped 16% to $77.62 per ton.

The largest users of the State's portland cement in 1984 were ready-mixed concrete companies, consuming nearly 64% of the output, followed, in descending order, by concrete product manufacturers, highway contractors, building material dealers, and other customers. Over 95% of the cement was shipped to consumers in bulk form; the remainder, in containers. Truck transportation was the principal mode for handling the shipments, accounting for 96% of the movements; the remainder was shipped by rail and other means.

Northwestern States Portland Cement Co. of Mason City, a principal cement manufacturing firm in the State, had two shutdowns totaling nearly 10 weeks during 1984. The shutdowns were necessitated by a slowdown in the demand for cement and an excessive buildup of inventories. Cement production was also halted for 24 days in May and June at Lehigh Portland Cement Co.'s Mason City plant owing to a strike by 142 workers, members of the United Cement, Lime, and Gypsum Workers Union.

Ash Grove Cement Co. of Overland Park, KS, announced plans to build a cement distribution terminal on a 5-acre site in southeast Des Moines. The project, estimated to cost between $500,000 and $1 million, was expected to be completed within 1 year.

**Clays.**—Clay production during 1984 came from nine mines operated by six companies in six counties. The quantity of clay produced in the State during 1984 increased 8% over the level attained in 1983. The average unit value of the clay produced in 1984 was $4.32 per short ton, a $1.33-per-ton decrease compared with the 1983 figure.

Cerro Gordo County was the leading county in the State in clay production, followed by Scott and Dallas Counties, respectively, which collectively accounted for nearly 81% of the State's output during the year.

Cement manufacturing consumed the bulk of the 1984 output; the remainder was used in making face brick.

**Gypsum.**—Crude gypsum production in Iowa during 1984 was from two underground and four open pit mines operated by five companies in Des Moines, Marion, and Webster Counties. Compared with 1983 figures, the quantity and value of crude gypsum produced in 1984 dropped 5% and 8%, respectively; however, the output of calcined gypsum rose 8% in quantity and 16% in value. The average unit value for the crude gypsum dropped 26 cents per short ton from that of 1983, while the average unit value of the calcined product in 1984 advanced $1.43 per ton over that of 1983.

Iowa ranked fourth in value among the 22 States reporting crude gypsum production in 1984. United States Gypsum Co.'s Fort Dodge plant in Webster County ranked eighth in output among the 71 gypsum plants operating nationwide during 1984.

Approximately three-fourths of the State's output of crude gypsum was from the open pit mines operated in Webster County.

**Lime.**—Production of lime in 1984 rose modestly in both quantity and value over the 1983 level. All of the State's quicklime and hydrated lime came from a single facility in Scott County operated by Linwood Stone Products Co. Inc.

During 1984, consumption of lime by Iowa users totaled 91,000 short tons. Approximately 80% of the consumption was quicklime and the remainder was hydrate material.

**Peat.**—Peat production during 1984 came from bogs in Linn, Muscatine, Winnebago, and Worth Counties at operations managed by four companies. Total output for the State was down slightly for the year compared with that of 1983. Approximately two-thirds of the material harvested was a reed-sedge-type peat, and the remainder, hypnum. The majority of the peat marketed was distributed in bulk form, and the remainder was packaged. Among the many uses for which peat was sold, golf courses and nurseries were the principal consumers, accounting for nearly two-thirds of the total.

**Perlite (Expanded).**—National Gypsum Co. and United States Gypsum Co. expanded perlite from mines in Western States at their gypsum processing plants in Webster County. The expanded material was used for plaster aggregate.

**Sand and Gravel (Construction).**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

In 1984, production of construction sand and gravel, the third leading commodity produced in the State in value and the second leading commodity in quantity, rose slightly over levels estimated for 1983. The material marketed during 1984 had a reported average unit value of $2.67 per short ton, a 4% decrease from that estimated to have been marketed in 1983.

Production during 1984 was reported by 109 firms and government agencies operating at 199 sites in 72 of the State's 99 counties. Polk County had the largest output in 1984, followed by Boone, Plymouth, and Sioux Counties, which together accounted for one-third of the State's total production. Operating a total of 32 pits, 5 companies produced more than 500,000 tons each.

Most of the construction sand and gravel produced during 1984 was used for road base and coverings, accounting for more than one-fourth of the total. Other uses, in descending order of consumption, included concrete aggregate, fill, and asphaltic concrete.

Approximately 94% of the material produced in 1984 was shipped by truck and the remainder was shipped primarily by water or was not transported.

### Table 4.—Iowa: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 2,410 | $7,948 | $3.30 |
| Plaster and gunite sands | W | W | 3.92 |
| Concrete products | 73 | 257 | 3.54 |
| Asphaltic concrete | 571 | 1,303 | 2.28 |
| Road base and coverings[1] | 3,958 | 7,593 | 1.92 |
| Fill | 725 | 1,488 | 2.05 |
| Snow and ice control | 98 | 310 | 3.18 |
| Railroad ballast | W | W | 5.00 |
| Other | 6,046 | 18,128 | 2.99 |
| Total or average | [2]13,882 | 37,027 | 2.67 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes road and other stabilization (lime).

[2] Data do not add to total shown because of independent rounding.

### Table 5.—Iowa: Construction sand and gravel sold or used by producers, by county

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Allamakee | 1 | 36 | $76 | 2 | 20 | $55 |
| Black Hawk | 5 | 301 | 964 | 6 | 388 | 1,234 |
| Boone | 3 | 672 | 1,644 | 3 | 1,167 | 3,219 |
| Buchanan | 1 | W | W | 3 | 37 | 65 |
| Buena Vista | 3 | W | W | 4 | 484 | 861 |
| Calhoun | 1 | 50 | 70 | 1 | 72 | 100 |
| Carroll | 4 | 173 | 397 | 3 | 110 | 266 |
| Cerro Gordo | 3 | W | W | 1 | 50 | 101 |
| Cherokee | 7 | 207 | 398 | -- | -- | -- |
| Clay | 14 | 247 | 342 | 10 | 179 | 478 |
| Clayton | 2 | 57 | 138 | 2 | 35 | 113 |
| Dallas | 5 | 296 | 957 | 10 | 568 | 1,600 |
| Delaware | 4 | W | W | 5 | 49 | 139 |
| Des Moines | 1 | W | W | 1 | 266 | W |
| Dickinson | 6 | 192 | 382 | 4 | 183 | 477 |
| Dubuque | -- | -- | -- | 1 | 8 | 20 |
| Emmet | 7 | W | W | 8 | 239 | 528 |
| Fayette | 1 | W | W | 1 | 8 | 25 |
| Floyd | 1 | 51 | 81 | 2 | 41 | 61 |
| Franklin | 3 | 91 | 172 | 2 | W | W |
| Greene | 11 | 235 | 524 | 6 | 122 | 246 |
| Guthrie | 3 | 92 | 210 | 3 | 60 | 108 |
| Hancock | 4 | 82 | 184 | 5 | 315 | 855 |
| Hardin | 2 | W | W | 3 | 127 | 186 |
| Howard | 3 | 15 | 45 | 3 | 18 | W |
| Jackson | 2 | W | W | 3 | 52 | 152 |
| Jones | 3 | 234 | 465 | 5 | 19 | 61 |
| Kossuth | 3 | 79 | 97 | 5 | 189 | 214 |
| Lee | 1 | 85 | 175 | 2 | 110 | 219 |
| Linn | 5 | 308 | 937 | 5 | 380 | 1,004 |
| Lyon | 8 | 130 | 290 | 7 | 177 | 406 |
| Marion | 3 | 228 | 734 | 3 | W | W |
| Marshall | 3 | 229 | 557 | 2 | W | W |
| Muscatine | 3 | 150 | 479 | 4 | 417 | 1,055 |
| O'Brien | 1 | W | W | 3 | 284 | 527 |
| Osceola | 4 | 159 | 304 | 2 | 234 | 557 |
| Palo Alto | 1 | W | W | 1 | 79 | 241 |
| Plymouth | 4 | 557 | 1,350 | 2 | 1,091 | 1,797 |
| Polk | 4 | 698 | 2,002 | 5 | 1,499 | 4,495 |
| Sac | 4 | 521 | 1,196 | 3 | W | W |
| Scott | -- | -- | -- | 2 | 34 | 279 |
| Sioux | 5 | 222 | 667 | 10 | 922 | 2,579 |

See footnotes at end of table.

### Table 5.—Iowa: Construction sand and gravel sold or used by producers, by county —Continued

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Tama | 1 | W | W | 1 | 65 | $224 |
| Webster | 4 | 90 | $219 | 3 | 191 | 435 |
| Winneshiek | 1 | 48 | 174 | 1 | 48 | 195 |
| Woodbury | 3 | 126 | 255 | 2 | W | W |
| Worth | 5 | 288 | 612 | 3 | 70 | 217 |
| Wright | 5 | W | W | 3 | 292 | 612 |
| Undistributed[1] | [r]33 | 3,117 | 8,522 | 33 | 3,182 | 11,019 |
| Total[2] | 201 | 10,064 | 25,618 | 199 | 13,882 | 37,027 |

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Appanoose, Audubon (1982), Benton, Butler, Cass, Cedar, Chickasaw (1984), Clinton, Grundy (1984), Hamilton, Humboldt, Ida (1982), Iowa, Jasper, Johnson, Keokuk, Louisa, Mitchell, Monona, Montgomery (1984), Page, Pottawattamie, Shelby, Story, Van Buren, Wapello, and Washington Counties and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

**Stone (Crushed).**—Stone is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

The estimated quantity of crushed stone produced during 1984 decreased approximately 4% in quantity and 1% in value compared with that of 1983. The estimated average unit price for the material marketed during 1984 was $4.20 per short ton.

Two of the State's crushed stone operations received special recognition during the year. B. L. Anderson Inc.'s Garrison Quarry was 1 of 13 quarries nationwide winning recognition in the National Crushed Stone Association's (NCSA) 1983 "About Face" beautification program. The company was honored with the NCSA Showplace Award, citing that the operation was well maintained and demonstrated a high standard of beautification and compatibility with its surroundings. In another event, L & W Construction Co. Inc., which operates quarries in Appanoose County, won a top award from the Iowa Limestone Producers Association. The award was in recognition of the company's land reclamation efforts at its Quarry No. 2 near Centerville.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN.

[2] Editorial assistant, Bureau of Mines, Minneapolis, MN.

### Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Davenport Cement Co., a subsidiary of Cementia Holdings AG. | Box 4288<br>Davenport, IA 52808 | Plant | Scott. |
| Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement AG. | Box 1882<br>Allentown, PA 18105 | do | Cerro Gordo. |
| The Monarch Cement Co | Humboldt, KS 66748 | do | Polk. |
| Northwestern States Portland Cement Co. | Box 1008<br>Mason City, IA 50401 | do | Cerro Gordo. |
| Clays: | | | |
| Davenport Cement Co., a subsidiary of Cementia Holdings AG. | Box 4288<br>Davenport, IA 52808 | Pit and plant | Scott. |
| Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement AG. | Box 1882<br>Allentown, PA 18105 | do | Cerro Gordo. |
| Midland Brick Co | Box A<br>Redfield, IA 50233 | Pits and plants | Dallas and Wapello. |
| Northwestern States Portland Cement Co. | Box 1008<br>Mason City, IA 50401 | Pit and plant | Cerro Gordo. |
| Sioux City Brick & Tile Co | Box 56<br>Sergeant Bluff, IA 51054 | Pits and plants | Dallas and Woodbury. |
| Gypsum: | | | |
| Celotex Corp., a subsidiary of Jim Walter Corp. | 1500 North Dale Mabry<br>Tampa, FL 33607 | Open pit mine and plant. | Webster. |
| Georgia-Pacific Corp | 133 Peachtree St. NE.<br>Atlanta, GA 30303 | do | Do. |
| Kaser Corp | Box 3569<br>Des Moines, IA 50322 | Underground mine | Marion. |

### Table 6.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Gypsum —Continued | | | |
| National Gypsum Co | 2001 Rexford Rd.<br>Charlotte, NC 28211 | Open pit mine and plant. | Webster. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | Underground mine and plant.<br>Open pit mine and plant. | Des Moines.<br>Webster. |
| Lime: | | | |
| Linwood Stone Products Co. Inc. | Route 2<br>Davenport, IA 52804 | Quarry and plant | Scott. |
| Peat: | | | |
| Eli Colby Co | Box 248<br>Lake Mills, IA 50450 | Bog and plant | Winnebago. |
| Colby Pioneer Peat Co | Box 8<br>Hanlontown, IA 50444 | do | Worth. |
| Hughes Peat Co | Route 2<br>Marion, IA 52302 | do | Linn. |
| Pikes Peat Co | Route 6, Box 21<br>Muscatine, IA 52761 | do | Muscatine. |
| Perlite (expanded): | | | |
| National Gypsum Co | 2001 Rexford Rd.<br>Charlotte, NC 28211 | Plant | Webster. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Do. |
| Sand and gravel (construction): | | | |
| L. G. Everist Inc | Box 829<br>Sioux Falls, SD 57102 | Pits and plants | Plymouth and Sioux. |
| G. A. Finley Inc | Box 406<br>Harlan, IA 51537 | do | Cass, Dallas, Montgomery, Page, Pottawattamie, Shelby. |
| Hallett Construction Co | Box 13<br>Boone, IA 50036 | do | Boone, Dallas, Franklin, Greene, Marshall, Polk, Sac, Story. |
| Martin Marietta Aggregates, Central Div. | Box 30013<br>Raleigh, NC 27622 | do | Appanoose, Linn, Marshall, Polk, Wapello. |
| Stevens Sand & Gravel Co. Inc | Route 6<br>Iowa City, IA 52240 | do | Johnson and Washington. |
| Van Dusseldorp Sand & Gravel Inc. | Box 156<br>Colfax, IA 50054 | do | Jasper and Marion. |
| Weaver Construction Co | Box 550<br>Iowa Falls, IA 50126 | do | Boone, Buena Vista, Cerro Gordo, Dallas, Franklin, Hamilton, Hardin, Kossuth, O'Brien, Sioux, Story, Webster, Wright. |
| Stone (crushed limestone, 1983): | | | |
| B. L. Anderson Inc | Box 2007<br>Cedar Rapids, IA 52401 | Quarries and plants | Benton, Cedar, Clinton, Jackson, Johnson, Jones, Linn, Tama. |
| Kaser Corp | Box 3569<br>Des Moines, IA 50322 | Underground mine, quarries, plants. | Des Moines, Fremont, Jasper, Keokuk, Marion, Monroe, Poweshiek, Washington. |
| Martin Marietta Aggregates, Central Div. | Box 30013<br>Raleigh, NC 27622 | do | Clarke, Decatur, Linn, Madison, Marshall, Polk, Story. |
| P. Niemann Construction Co | 106 North Maple St.<br>Sumner, IA 50674 | Quarries and plants | Bremer, Buchanan, Butler, Chickasaw, Fayette, Winneshiek. |
| River Products Co | 220 Savings & Loan Bldg.<br>Iowa City, IA 52240 | Underground mine, quarries, plants. | Johnson, Louisa, Washington. |
| Schildberg Construction Co. Inc. | Box 358<br>Greenfield, IA 50849 | Quarries and plants | Adair, Adams, Cass, Madison, Pottawattamie, Union. |
| Welp & McCarten Inc | Box W, 522 South 22d St.<br>Fort Dodge, IA 50501 | Underground mines, quarries, plants. | Black Hawk, Hancock, Webster, Worth. |

# The Mineral Industry of Kansas

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Kansas Geological Survey for collecting information on all nonfuel minerals.**

**By James J. Hill,[1] David A. Grisafe,[2] and Wanda J. West[3]**

The value of nonfuel mineral production in Kansas was $312 million in 1984, nearly 17% greater than that of 1983 and the highest value reported in 6 years. The State ranked 24th nationally in nonfuel mineral production value after ranking 25th in 1983. Output increased for all minerals produced in the State except for masonry cement, rock salt, sand and gravel, and dimension stone.

Kansas led the Nation in the production of helium. Cement sales continued to account for the greatest portion of the State's mineral commodity value, followed by, in order of importance, salt, crushed stone, Grade-A helium, and construction sand and gravel.

**Table 1.—Nonfuel mineral production in Kansas[1]**

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Clays thousand short tons | 718 | $3,921 | 918 | $5,537 |
| Gem stones | NA | 1 | NA | 1 |
| Helium: | | | | |
| Crude million cubic feet | 188 | 3,572 | 402 | 8,844 |
| Grade-A do | 775 | 27,125 | 1,015 | 38,063 |
| Salt[2] thousand short tons | 1,719 | 67,195 | 1,712 | 71,558 |
| Sand and gravel: | | | | |
| Construction do | [e]12,400 | [e]26,600 | 11,796 | 26,358 |
| Industrial do | 199 | 2,184 | W | W |
| Stone (crushed) do | [r]12,687 | [r]45,121 | [e]13,600 | [e]48,500 |
| Combined value of cement, gypsum, lime, pumice, salt (brine), stone (dimension), and value indicated by symbol W | XX | 91,866 | XX | 113,149 |
| Total | XX | [r]267,585 | XX | 312,010 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes salt in brines; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Kansas, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Allen | W | W | Cement, stone (crushed), clays. |
| Anderson | (2) | $188 | Stone (crushed). |
| Atchison | (2) | W | Do. |
| Barber | W | W | Gypsum. |
| Barton | W | 89 | Clays. |
| Bourbon | (2) | W | Stone (crushed). |
| Butler | (2) | 1,214 | Do. |
| Chase | (2) | 77 | Stone (dimension). |
| Chautauqua | (2) | 250 | Stone (crushed). |
| Cherokee | W | 185 | Clays, stone (crushed). |
| Cheyenne | $25 | (3) | |
| Clark | 22 | (3) | |
| Clay | W | W | Stone (crushed). |
| Cloud | W | W | Clays. |
| Coffey | (2) | 381 | Stone (crushed). |
| Cowley | 329 | 990 | Stone (crushed), stone (dimension). |
| Crawford | W | 748 | Stone (crushed), clays. |
| Decatur | 83 | (3) | |
| Dickinson | W | 1,041 | Stone (crushed). |
| Doniphan | (2) | W | Do. |
| Douglas | W | W | Do. |
| Edwards | 87 | (3) | |
| Elk | (2) | W | Stone (crushed). |
| Ellis | 216 | W | Do. |
| Ellsworth | 8,997 | W | Helium, salt, clays. |
| Finney | W | (3) | |
| Ford | W | (3) | |
| Franklin | W | W | Stone (crushed), clays. |
| Geary | W | (3) | |
| Gove | 50 | (3) | |
| Graham | 35 | 59 | Stone (crushed). |
| Grant | W | W | Helium. |
| Gray | 33 | (3) | |
| Greeley | 14 | (3) | |
| Greenwood | 153 | W | Stone (crushed). |
| Hamilton | 165 | (3) | |
| Harper | W | (3) | |
| Harvey | W | (3) | |
| Haskell | W | (3) | |
| Hodgeman | 28 | (3) | |
| Jackson | 21 | (3) | |
| Jefferson | (2) | 2,525 | Stone (crushed). |
| Jewell | W | W | Stone (crushed), clays. |
| Johnson | W | 6,719 | Stone (crushed). |
| Kearny | 346 | (3) | |
| Kingman | 36 | (3) | |
| Kiowa | 274 | (3) | |
| Labette | (2) | 944 | Stone (crushed). |
| Leavenworth | (2) | W | Do. |
| Lincoln | 73 | W | Do. |
| Linn | (2) | W | Do. |
| Logan | 13 | (3) | |
| Lyon | 49 | W | Stone (crushed). |
| McPherson | W | W | Clays. |
| Marion | (2) | W | Stone (crushed). |
| Marshall | W | W | Gypsum, stone (crushed). |
| Meade | 40 | (3) | |
| Miami | (2) | W | Stone (crushed). |
| Montgomery | W | W | Cement, stone (crushed), clays. |
| Morris | (2) | W | Stone (crushed). |
| Morton | W | W | Helium. |
| Nemaha | (2) | 252 | Stone (crushed). |
| Neosho | W | W | Cement, stone (crushed), clays. |
| Ness | 94 | (3) | |
| Norton | W | W | Pumice, stone (crushed). |
| Osage | (2) | W | Stone (crushed). |
| Ottawa | 112 | (3) | |
| Pawnee | 142 | (3) | |
| Phillips | 35 | (3) | |
| Pottawatomie | 104 | W | Stone (crushed), stone (dimension). |
| Pratt | W | (3) | |
| Rawlins | 20 | (3) | |
| Reno | 52,788 | 48,967 | Salt. |
| Republic | W | W | Sand (industrial). |
| Rice | W | W | Salt, stone (crushed). |
| Riley | W | W | Stone (crushed), stone (dimension). |
| Rooks | 19 | (3) | |
| Rush | W | W | Helium. |
| Russell | 47 | (3) | |
| Saline | W | (3) | |

See footnotes at end of table.

### Table 2.—Value of nonfuel mineral production in Kansas, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Sedgwick | W | W | Salt. |
| Seward | $314 | (3) | |
| Shawnee | 798 | W | Stone (crushed). |
| Sheridan | 51 | (3) | |
| Sherman | W | W | Lime. |
| Smith | (2) | W | Stone (crushed). |
| Stafford | W | (3) | |
| Stevens | 46 | (3) | |
| Sumner | W | (3) | |
| Thomas | 144 | (3) | |
| Trego | 105 | $12 | Stone (crushed). |
| Wabaunsee | (2) | -- | |
| Wallace | 4 | (3) | |
| Washington | W | (3) | |
| Wichita | 20 | (3) | |
| Wilson | W | W | Cement, stone (crushed), clays. |
| Woodson | W | W | Clays. |
| Wyandotte | W | W | Cement, stone (crushed), sand (industrial). |
| Undistributed[4] | [r]149,892 | 176,345 | |
| Sand and gravel (construction) | XX | [e]26,600 | |
| Stone: | | | |
| Crushed | [e]41,100 | XX | |
| Dimension | W | XX | |
| Total | [r]256,924 | [5]267,585 | |

[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] Brown, Comanche, Lane, Mitchell, Osborne, Scott, and Stanton Counties are not listed because no nonfuel mineral production was reported.

[2] Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

### Table 3.—Indicators of Kansas business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 2,408 | 2,426 | 2,438 |
| Total civilian labor force | do | 1,186 | 1,186 | 1,197 |
| Unemployment | do | 74 | 72 | 63 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 18.8 | 17.2 | 17.8 |
| Nonmetallic minerals except fuels[1] | do | 1.2 | 1.2 | 1.2 |
| Coal mining[1] | do | .5 | .4 | .4 |
| Oil and gas extraction[1] | do | 17.2 | 15.6 | 16.2 |
| Manufacturing total | do | 168.8 | 164.7 | 176.5 |
| Primary metal industries | do | 2.9 | 2.4 | 3.2 |
| Stone, clay, and glass products | do | 6.6 | 6.8 | 7.1 |
| Chemicals and allied products | do | 8.5 | 8.0 | 8.2 |
| Petroleum and coal products | do | 4.5 | 3.7 | 3.3 |
| Construction | do | 39.0 | 39.7 | 42.2 |
| Transportation and public utilities | do | 61.4 | 62.2 | 64.1 |
| Wholesale and retail trade | do | 227.9 | 229.0 | 238.3 |
| Finance, insurance, real estate | do | 48.9 | 50.0 | 51.5 |
| Services | do | 172.8 | 175.9 | 183.7 |
| Government and government enterprises | do | 183.8 | 182.9 | 186.4 |
| Total | do | 921.4 | 921.6 | 960.5 |
| Personal income: | | | | |
| Total | millions | $28,246 | $29,146 | $32,300 |
| Per capita | | $11,731 | $12,015 | $13,248 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 39.1 | 40.2 |
| Mining | | 41.9 | 43.1 | 44.6 |
| Total average hourly earnings, production workers | | $8.80 | $9.23 | $9.40 |
| Mining | | $9.20 | $9.03 | $9.38 |

See footnotes at end of table.

### Table 3.—Indicators of Kansas business activity —Continued

| | | 1982ʳ | 1983 | 1984ᵖ |
|---|---|---|---|---|
| Earnings by industry: | | | | |
| Farm income | millions | $1,211 | $825 | $1,300 |
| Nonfarm | do | $17,900 | $18,902 | $20,693 |
| Mining total | do | $711 | $543 | $601 |
| Nonmetallic minerals except fuels | do | $21 | $24 | $24 |
| Coal mining | do | $16 | $14 | $15 |
| Oil and gas extraction | do | $674 | $505 | $563 |
| Manufacturing total | do | $3,969 | $4,070 | $4,605 |
| Primary metal industries | do | $70 | $64 | $88 |
| Stone, clay, and glass products | do | $164 | $180 | $191 |
| Chemicals and allied products | do | $234 | $219 | $232 |
| Petroleum and coal products | do | $176 | $148 | $129 |
| Construction | do | $984 | $1,085 | $1,218 |
| Transportation and public utilities | do | $1,719 | $1,863 | $1,953 |
| Wholesale and retail trade | do | $3,184 | $3,343 | $3,638 |
| Finance, insurance, real estate | do | $932 | $1,058 | $1,164 |
| Services | do | $3,112 | $3,453 | $3,829 |
| Government and government enterprises | do | $3,224 | $3,416 | $3,606 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 8,628 | 14,214 | 16,164 |
| Value of nonresidential construction | millions | $392.1 | $667.1 | $518.9 |
| Value of State road contract awards | do | $73.7 | $238.3 | $277.5 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 974 | 1,004 | 1,266 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $256.9 | $267.6 | $312.0 |
| Value per capita | | $106 | $110 | $128 |

ᵖPreliminary. ʳRevised.

[1] Kansas Department of Human Resources, Division of Employment.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

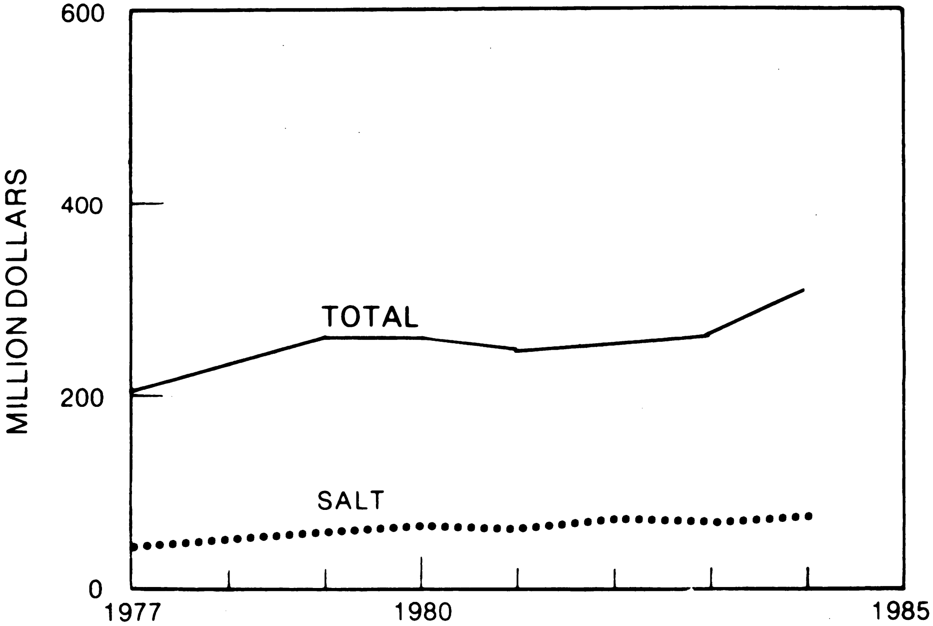

Figure 1.—Value of salt and total value of nonfuel mineral production in Kansas.

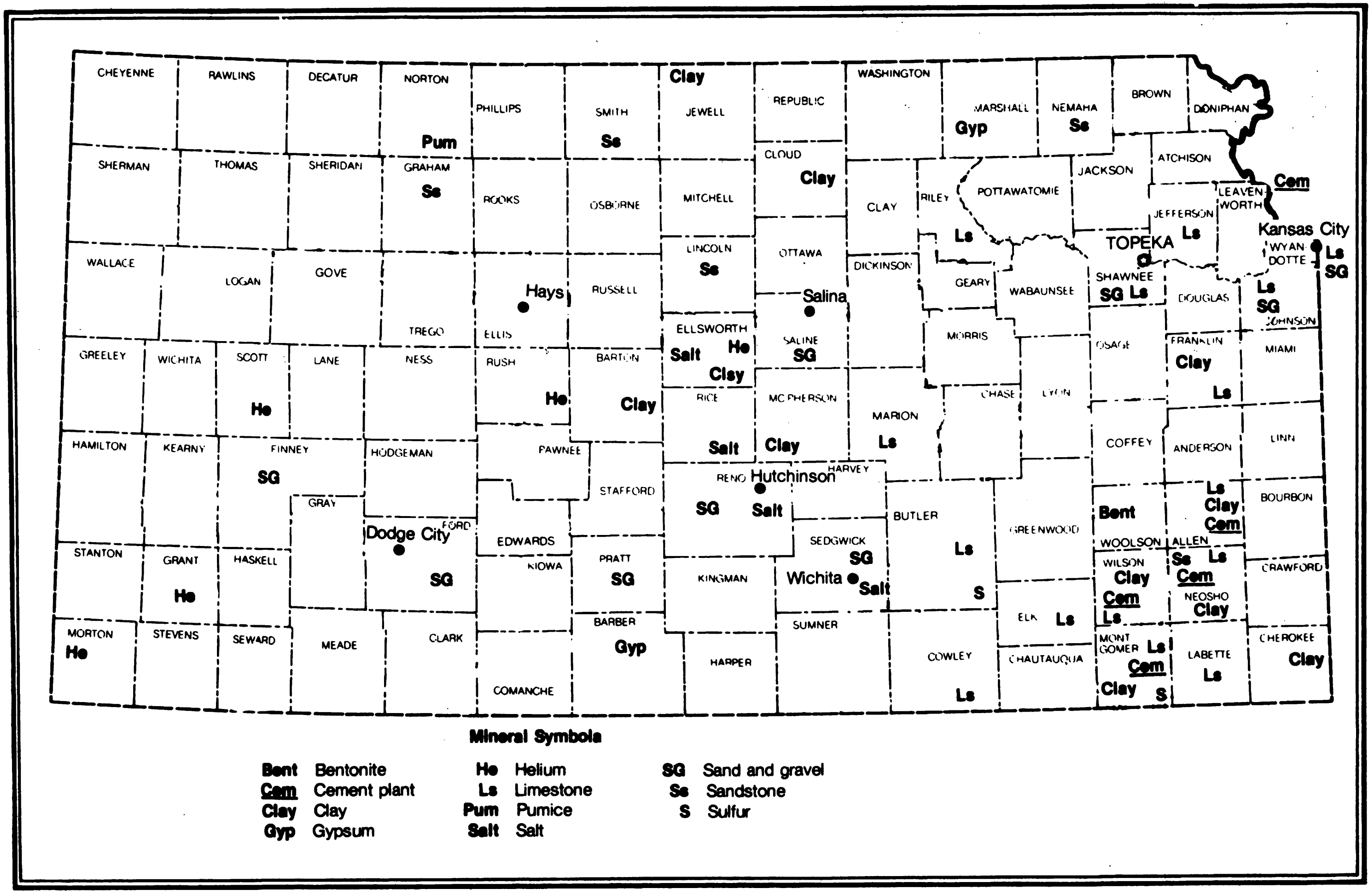

Figure 2.—Principal mineral producing localities in Kansas.

**Trends and Developments.**—Increased construction activity gave impetus to sales of several mineral commodities produced in the State. The State approved expenditure of $277.5 million in road funds in 1984 as part of a 5-year, $1 billion highway improvement program authorized in 1983; this compared with $238.3 million in contracts awarded in 1983. The Federal Department of Transportation authorized $190 million for work in Kansas in 1984, compared with $157 million in 1983. The increase in Federal funding can be attributed to the Surface Transportation Assistance Act of 1982 that distributes revenue to the States from the 4-cent-per-gallon Federal fuels tax increase that went into effect in April 1983.

The U.S. Department of Commerce reported a 13.7% increase in the number of permits issued for the construction of public and private residential units. Nonresidential construction was valued at $518.9 million during 1984.

**Employment.**—The Kansas Department of Human Resources, Division of Employment, reported a monthly average of 1,289 persons employed in the mining and quarrying of nonmetallic minerals (excluding fuels) in 1984, the highest monthly average since 1981. The monthly average in 1983 was 1,259 persons. In 1984, employment peaked in October with 1,392 workers reported. The year's low was in January when 1,085 persons were employed. Historically, January, February, and March are the lowest months of employment because many crushed stone and sand and gravel operations suspend operations for the winter months or operate at reduced levels.

**Legislation and Government Programs.**—Two mining-related pieces of legislation were enacted during 1984. House Bill 2839 required that for every foot of depth excavated at a quarry or minesite, at least 1 foot of unexcavated land must remain between the excavation and the property line of the person who owns the land being excavated. An exception was made for adjoining lands when both properties are being excavated for mining or quarrying purposes. The bill also provided for a $1,000 civil penalty for violations, plus the award of actual damages.

Senate Bill 816 authorized the Mined Land Conservation and Reclamation Board to assess a fee of not less than $.03 and not more than $.10 per ton of coal extracted. This fee was in addition to the $50 basic fee based on acreage and would finance part of the operations of the Mined Land Division of the Kansas Corporation Commission.

The Kansas Geological Survey continued its research and service-related earth-science programs during 1984. Emphasis was on ground water, geophysics, subsurface geology, and geologic data automation.

In early 1984, the cooperative effort between the Kansas and Missouri Geological Surveys in conjunction with the U.S. Geological Survey Conterminous United States Mineral Appraisal Program (CUSMAP) proceeded from the planning stage to full operation. The program was designed to assess the mineral resource potential of the Joplin 1° by 2° Quadrangle. Phases of the investigation included modeling of known deposits, mapping the surface and subsurface geology, geochemical and geophysical studies, remote sensing, and development of a comprehensive data base. The project, expected to be completed in 1988, will result in a comprehensive analysis of the resource potential within the Joplin Quadrangle.

By yearend, 12 deep holes (to basement rock) were examined, which included the collecting and splitting of cuttings at 10-foot intervals, binocular microscope examination of the cuttings and their hydrochloric acid insoluble residues, and the emission spectrographic determination of 36 elements within these residues. In addition, an aeromagnetic survey of the quadrangle was completed using east-west traverses one-half mile apart, with north-south tie lines. Also, approximately one-half of the gravity measurements in the quadrangle were completed. Some remote-sensing data were obtained, including color infrared (false color photography), high-altitude black-and-white photography, and thematic mapper imagery (natural color).

In the spring of 1984, the University Press of Kansas issued the Kansas Geological Survey publication "Kansas Geology," an introduction to landscapes, rocks, minerals, and fossils of the State.

In the fall of 1984, the U.S. Environmental Protection Agency (EPA) began a feasibility study of the pollution problems in the Tar Creek area, a portion of the Tri-State lead-zinc mining district that extends into southeastern Kansas and covers portions of Missouri and Oklahoma. The investigation will examine the extent and magnitude of ground and surface water contamination resulting from the abandoned lead-zinc mines in the area. EPA has labeled the 40-square-mile area as one of the most dangerous hazardous waste sites in the Nation. Kansas and Oklahoma had requested money from EPA under the Environmental Response, Compensation, and Liability Act of 1980 (Superfund) to help resolve the pollution problems.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Cement.**—Nationally, Kansas ranked 11th in sales of portland cement and 17th in sales of masonry cement. Portland cement sales increased 15%, and masonry cement sales dropped about 3% during 1984. Average value per short ton increased about 6% for portland cement and 16% for masonry cement.

The 5 companies operating cement plants in the State had a total of 14 kilns and produced both portland and masonry cements. All of the plants produced Types I and II, general use and moderate heat portland cement. Other types produced by one or more plants included Type III, high-early-strength, an oil-well cement, and a waterproof portland cement. Shipments to consumers were mostly in bulk form by rail and truck.

Approximately 2.8 million tons of cement rock and limestone, 340,000 tons of clay and shale, and 87,000 tons of gypsum, along with lesser quantities of sand and sandstone were consumed in the cement manufacturing process.

About 1,243,000 tons of portland cement was consumed in the State, along with 23,000 tons of masonry cement.

In March, General Portland Inc. was granted a temporary permit by the EPA to test burn solvent wastes at its Fredonia cement plant for use as a supplemental fuel. The wastes were stringently tested to ensure that they contained no detrimental materials such as pesticides and herbicides. General Portland realized substantial savings in fuel costs while testing the solvent fuels and expected to receive a permanent permit for their use from EPA in 1985. Previously, the company used coal and coke as the primary fuel for the Fredonia plant with natural gas as a backup source. The firm estimated that as much as 50% of its fuel needs could be met with solvent wastes.

General Portland's Fredonia facility was also involved in a 6-week strike that was settled in November.

The Monarch Cement Co. installed a new roller mill at its Humboldt plant that became operational in March.

**Clays.**—Kansas ranked 16th nationally in clay and shale output. Production increased about 28%, and value increased 41% during 1984. Common clay was produced in 11 counties by 11 companies. The manufacture of portland cement accounted for 43% of the common clay usage. Lightweight aggregate for concrete blocks and other structural concrete products accounted for the second major use. Common clay was also used to manufacture common and face brick, ceramic floor and wall tile, drain tile, roof tile, and sewer tile.

Micro-Lite Inc. mined a micaceous bentonitic clay in Woodson County for use in manufacturing feed and fertilizer supplements.

Kansas Brick & Tile Co. Inc. at Hoisington, Barton County, began to modernize its facility by installing a new tunnel kiln and grinding equipment, costing approximately $4.5 million, that will be located adjacent to existing facilities. Completion of the project was expected in mid-1985. The company manufactures a variety of colored brick and uses blends of clays from three pits in the Cretaceous Dakota Formation.

In February, Acme Brick Co., a subsidiary of Justin Industries Inc., upgraded its facilities at Weir, Cherokee County, by replacing burners and installing a refractory fiber lining on a portion of its tunnel kiln. The improvements resulted in a 25% reduction in fuel consumption.

In April, Buildex Inc., a division of Clemens Coal Co., purchased the assets of the Lightweight Aggregate Div. of the Carter Waters Corp., Kansas City, MO. The acquisition of the plant at New Market, MO, coupled with the existing Buildex plants at Ottawa, Franklin County, and Marquette, McPherson County, was expected to increase the annual production capacity of Buildex to over 700,000 cubic yards of expanded shale lightweight aggregate per year and to expand the company's market area.

Cloud Ceramics, a division of General Finance Inc., upgraded its Concordia facility, Cloud County, by purchasing a $250,000 pug mill and extruder unit to replace a unit that, since 1957, had produced over 650 million brick. The company also installed a new crusher for producing grog from scrap brick. Cloud Ceramics planned to purchase a new cutter during 1985, further improving its plant. Bishop Brick Co. at Humboldt, Allen County, underwent a general rejuvenation during 1984, installing a new periodic kiln and rebuilding its shale planer used in mining. Bishop acquired the facility in 1983; it was formerly operated by Humboldt Brick & Tile Co.

**Gypsum.**—Kansas ranked eighth nationally in crude gypsum production. Output and value increased about 11% and 12%, respectively, because of increased demand by the construction industry. Two companies mined gypsum—Georgia-Pacific Corp. at its Blue Rapids Mine in Marshall County and National Gypsum Co. at its Sun City Mine in Barber County. Both companies operated underground mines; National Gypsum also had a surface operation. National Gypsum's Sun City Mine ranked sixth nationally in production.

National Gypsum and Georgia-Pacific calcined gypsum at their operations. Production and value of the calcined product increased about 1% and 7%, respectively.

**Helium.**—Kansas continued to rank first in production of crude and Grade-A helium. Production and value of Grade-A helium increased about 31% and 40%, respectively. Crude helium production jumped from 188 to 402 million cubic feet in 1984. Average value of crude helium increased about $0.003 per cubic foot. Strong demand by government and industry accounted for the increased sales.

Grade-A helium was processed by two companies—Kansas Refined Helium Co. at Otis, Rush County, and Union Carbide Corp., Linde Div., with plants at Bushton, Ellsworth County, Elkhart, Morton County, and Ulysses, Grant County. Union Carbide's Ulysses operation was purchased from Cities Service Cryogenics Inc. on October 1, 1984.

Crude helium was processed by Cities Service Cryogenics Inc. at Scott City, Scott County, Cities Service Helex Co. at Ulysses, Rush County, and Northern Helex Co. at Bushton, Ellsworth County.

Major end uses of helium were cryogenics, pressurizing and purging, and welding.

**Lime.**—Quicklime was produced by The Great Western Sugar Co. for use in refining sugar at its sugar beet plant near Goodland, Sherman County. Production and value increased 112% and 193%, respectively, mainly because output of sugar at the refinery increased. About 65,000 short tons of quicklime was consumed in the State, along with 16,000 tons of hydrated lime.

Prolonged low sugar prices and other financial difficulties prompted Hunt International Resources Corp. to put the assets of Great Western Sugar and its subsidiaries up for sale at yearend.

**Perlite (Expanded).**—Lite-Weight Products Inc. expanded crude perlite, mined in the Western States, at its plant in Kansas City, Wyandotte County. Sales increased 25% during 1984. Average value increased about $14 per short ton. Sales were for use as a filter aid and other miscellaneous uses.

**Pumice and Pumicite.**—Kansas was one of eight States producing pumice, ranking seventh. Production increased about 12%, although average value dropped about $19 per short ton. All production was in Norton County. Major sales were for use as an absorbent, filter aid, and an abrasive.

Calvert Mines Inc., the State's sole producer, was acquired by Bernard Friedman of Allentown, PA, during 1984, and the company name changed to Calvert Corp. The firm continued to operate under the same management.

**Salt.**—Of the 16 States reporting salt production, Kansas ranked fifth in output. Sales and value increased about 1% and 7%, respectively. Salt was produced by five companies with operations in Ellsworth, Reno, Rice, and Sedgwick Counties. Three companies, American Salt Co., Carey Salt Co., and Independent Salt Co., operated underground mines. Cargill Inc. and Morton Thiokol Inc. evaporated salt from brines. American Salt and Carey Salt also had evaporated brine operations. In addition, a sixth company, Vulcan Materials Co., Chemicals Div., electrolytically separated chlorine, hydrogen, and sodium hydroxide at its brine operations near Wichita, Sedgwick County.

Salt was sold for ice control, the agricultural and meatpacking industries, table salt, and as a hard-water conditioner.

In April, American Salt signed a letter of intent to sell its salt operations near Lyons and another salt mining operation near Salt Lake City, UT, to Diamond Crystal Salt Co. of St. Clair, MI, subject to the board of directors' approval. However, Diamond Crystal's board of directors rejected the proposal in June but declined to elaborate on the subject. American Salt indicated it would seek another buyer.

In another action, American Salt was found liable in U.S. District Court for $3 million in damages and $10 million in punitive damages in a suit involving pollution of an aquifer. The plaintiffs stated that they were unable to irrigate their land and grow corn because of the salt pollution and were forced to grow wheat and milo, less valuable crops. The court's ruling acknowledged that future damages would accrue as each annual crop is damaged, and that plaintiffs would have to file a claim on those damages within 2 years. American Salt was ordered to install a well-monitoring system to determine the nature and extent of the pollution as a first step in the cleanup process. The company was required to file progress reports every other month and to present a final report on cleanup alternatives within 8 months.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Nationally, Kansas ranked 24th in the production of sand and gravel for construction purposes. Output decreased nearly 5% compared with 1983 figures, and the value decreased about 1%. Construction sand and gravel was produced by 112 companies and government agencies at 271 pits in 66 of the State's 105 counties. Sedgwick County led the State's production.

Major uses of construction sand and gravel were for concrete aggregate, road base and coverings, asphaltic concrete, and fill.

### Table 4.—Kansas: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 2,680 | $6,424 | $2.40 |
| Plaster and gunite sands | W | W | 2.86 |
| Concrete products | 100 | 330 | 3.28 |
| Asphaltic concrete | 1,139 | 2,546 | 2.24 |
| Road base and coverings[1] | 2,510 | 4,534 | 1.81 |
| Fill | 1,106 | 1,687 | 1.53 |
| Snow and ice control | 122 | 345 | 2.83 |
| Railroad ballast | W | W | 2.50 |
| Other | 4,139 | 10,492 | 2.53 |
| Total or average | 11,796 | 26,358 | 2.23 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes road and other stabilization (cement).

### Table 5.—Kansas: Construction sand and gravel sold or used by producers, by county

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Barber | 7 | 25 | $30 | 5 | 9 | $11 |
| Barton | 2 | 349 | 838 | 2 | W | W |
| Cherokee | 3 | W | W | 2 | 142 | 207 |
| Cheyenne | 1 | 13 | 25 | 2 | W | 73 |
| Clark | 5 | W | 22 | 4 | 43 | 71 |
| Cloud | 1 | 122 | W | 1 | W | W |
| Coffey | -- | -- | -- | 2 | 30 | 30 |
| Comanche | -- | -- | -- | 1 | 8 | 8 |
| Cowley | 3 | 163 | 329 | 3 | 290 | 658 |
| Decatur | 2 | 45 | 83 | 3 | 35 | 91 |
| Edwards | 3 | 49 | 87 | 3 | 49 | 109 |
| Ellis | 2 | 61 | 216 | 4 | 246 | 512 |
| Ellsworth | 3 | 23 | 36 | 3 | W | W |
| Finney | 2 | W | W | 6 | 327 | 802 |
| Ford | 3 | W | W | 7 | 346 | 1,141 |
| Geary | 3 | W | W | 3 | 174 | 397 |
| Gove | 2 | W | 50 | -- | -- | -- |
| Graham | 1 | 20 | 35 | -- | -- | -- |
| Grant | 1 | W | 19 | 2 | 52 | 65 |
| Gray | 1 | 27 | 33 | 1 | 5 | 7 |
| Greeley | 2 | W | 14 | 4 | 5 | 6 |
| Greenwood | 3 | 60 | 153 | 4 | 73 | 154 |
| Hamilton | 2 | 55 | 165 | 1 | 18 | 18 |
| Harper | 3 | W | W | 55 | 84 | 96 |
| Harvey | 2 | W | W | 2 | 261 | 583 |
| Haskell | 1 | W | W | 3 | 196 | 326 |
| Hodgeman | 2 | 24 | 28 | 1 | 3 | 4 |
| Jackson | 1 | W | 21 | 7 | 31 | 46 |

See footnotes at end of table.

## Table 5.—Kansas: Construction sand and gravel sold or used by producers, by county —Continued

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Kearny | 4 | 98 | $346 | 8 | 241 | $1,260 |
| Kingman | 2 | 20 | 36 | -- | -- | -- |
| Kiowa | 2 | 153 | 274 | 2 | 65 | 75 |
| Lincoln | 20 | 61 | 73 | 1 | 10 | W |
| Logan | 1 | 13 | 13 | 2 | 17 | 46 |
| Lyon | 2 | 49 | 49 | 6 | 9 | 9 |
| McPherson | 1 | 6 | 6 | -- | -- | -- |
| Marshall | 2 | W | W | 3 | 105 | 311 |
| Meade | 1 | 27 | 40 | 2 | 53 | 91 |
| Morton | 1 | 2 | 4 | 2 | 22 | 46 |
| Neosho | 1 | 85 | 248 | -- | -- | -- |
| Ness | 6 | 94 | 94 | 6 | 142 | 142 |
| Norton | 6 | 36 | 34 | 5 | 60 | 60 |
| Ottawa | 2 | 34 | 112 | 1 | 16 | 64 |
| Pawnee | 2 | 58 | 142 | 4 | 78 | 232 |
| Phillips | 2 | 18 | 35 | 2 | 10 | 26 |
| Pottawatomie | 2 | 52 | 104 | 2 | 55 | 104 |
| Pratt | 2 | W | W | 3 | 399 | 1,468 |
| Rawlins | 2 | 10 | 20 | -- | -- | -- |
| Reno | 5 | 512 | 1,006 | 4 | 476 | 1,027 |
| Rooks | 2 | 10 | 19 | 1 | 12 | 31 |
| Russell | 5 | 37 | 47 | 4 | 56 | 89 |
| Sedgwick | 13 | 2,189 | 3,765 | 16 | 2,336 | 4,794 |
| Seward | 5 | 108 | 314 | 5 | 124 | 316 |
| Shawnee | 7 | 411 | 798 | 7 | 879 | 1,947 |
| Sheridan | 8 | 51 | 51 | 8 | 77 | 77 |
| Sherman | 12 | W | W | 2 | 34 | 88 |
| Stevens | 2 | 46 | 46 | 2 | 42 | 42 |
| Sumner | 1 | W | W | 1 | 99 | 173 |
| Thomas | 4 | 74 | 144 | 1 | 16 | 37 |
| Trego | 11 | 72 | 105 | 10 | 113 | 200 |
| Wallace | 1 | 2 | 4 | -- | -- | -- |
| Washington | 1 | W | W | 4 | 134 | 218 |
| Wichita | 1 | W | 20 | 1 | 22 | 24 |
| Wyandotte | 8 | W | W | 4 | 999 | 1,939 |
| Undistributed[1] | 21 | 4,355 | 10,479 | 21 | 2,672 | 6,005 |
| Total[2] | 229 | 9,720 | 20,612 | 271 | 11,796 | 26,358 |

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Clay, Dickinson, Douglas, Johnson, Republic, Rice, Riley, Saline, Stafford, and Wilson Counties and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

*Industrial.*—Nationally, Kansas ranked 26th of 38 States in industrial sand production. Production and value dropped 29% and 28%, respectively, in 1984. Industrial sand was produced in Republic and Wyandotte Counties by three companies. Wyandotte County, with two operations, led the State's production. Sales were made for sandblasting and other uses.

**Stone.**—Stone is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Crushed stone production and value were estimated to have increased about 7% in 1984. Historically, Kansas' crushed stone has been used for agricultural limestone, cement and lime manufacture, concrete and bituminous aggregate, filler stone, railroad ballast, and other miscellaneous uses.

In June, Midwest Minerals Inc., headquartered in Pittsburg, Crawford County, purchased the quarrying assets of O'Brien Rock Co. of St. Paul, Neosho County. The purchase included all crushing equipment, quarries at Chetopa, Labette County, Urbana, Neosho County, and South Mound, Neosho County, and real estate near South Mound. The acquisition was expected to improve the supply and efficiency of Midwest Minerals' southeastern Kansas operations that supply agricultural lime and crushed stone. Midwest Minerals also has operations in neighboring areas of Missouri and Oklahoma.

Quartzite Stone Co. Inc., at Lincoln, Lincoln County, was acquired by J. H. Shears & Sons, a sand and gravel producer, of Hutchinson, Reno County. The acquisition expanded Shears' market area and product lines. Both companies produced aggregate used in concrete and road construction. Quartzite Stone began to install a new $2 million crushing plant that was expected to be completed during 1985.

The National Limestone Institute awarded Bayer Construction Co. Inc. a special safety certificate for 5 years of operation without a disabling injury at its Martin Quarry in Clay County.

*Dimension.*—Production and value of dimension stone were estimated to have dropped 19% and 15%, respectively, during 1984.

**Sulfur (Recovered).**—Sulfur was recovered as a byproduct of the petroleum refining operations of Texaco Refining & Marketing Co. at El Dorado in Butler County and Farmland Industries Inc. at Coffeyville in Montgomery County. Sales increased 19% during 1984, but the average value per metric ton dropped $6.39.

Texaco acquired the El Dorado operation in February when it purchased Getty Refining & Marketing Co.

## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Ash Grove Cement Co.[1] [2] | Box 25900<br>Overland Park, KS 66225 | Plant and quarry | Neosho. |
| General Portland Inc., Victor Div., LaFarge Corp.[1] [2] | 7701 East Kellogg St.<br>Suite 240<br>Wichita, KS 67207 | do | Wilson. |
| Lehigh Portland Cement Co., Heidelberger Zement AG[1] [2] | 718 Hamilton Mall<br>Allentown, PA 18105 | do | Montgomery. |
| Lone Star Industries Inc.[2] | Box 12449<br>Dallas, TX 75225 | do | Wyandotte. |
| The Monarch Cement Co.[1] [2] | Box 187<br>Humboldt, KS 66748 | do | Allen. |
| Clays: | | | |
| Buildex Inc., a division of Clemens Coal Co. | Box 62299<br>Pittsburg, KS 66762 | Pits and plants | Franklin and McPherson. |
| Cloud Ceramics, a division of General Finance Inc. | Box 369<br>Concordia, KS 66901 | Pits and plant | Cloud. |
| W. S. Dickey Clay Manufacturing Co | Box 6<br>Pittsburg, KS 66762 | Pit and plant | Cherokee. |
| Ideal Basic Industries Inc | Box 8789<br>Denver, CO 80201 | Pit | Jewell. |
| Justin Industries Inc., Acme Brick Co | Box 98<br>Kanopolis, KS 67454 | Pits and plants | Cherokee and Ellsworth. |
| Kansas Brick & Tile Co. Inc | Box 540<br>Hoisington, KS 67544 | Pit and plant | Barton. |
| Micro-Lite Inc | 1100 South Katy St.<br>Chanute, KS 66720 | do | Woodson. |
| Gypsum: | | | |
| Georgia-Pacific Corp | 133 Peachtree St., NE.<br>Atlanta, GA 30303 | Underground mine and plant. | Marshall. |
| National Gypsum Co | 2001 Rexford Rd.<br>Charlotte, NC 28211 | Open pit, underground mine, plant. | Barber. |
| Helium: | | | |
| Cities Service Helex Co | Route 1, Box 14D<br>Satanta, KS 67870 | Plants | Rush and Scott. |
| Kansas Refined Helium Co | Otis, KS 67565 | Plant | Rush. |
| Northern Helex Co | Bushton, KS 67427 | do | Ellsworth. |
| Union Carbide Corp., Linde Div | do | Plants | Ellsworth, Grant, Morton. |
| Lime: | | | |
| The Great Western Sugar Co | Box 5308<br>Denver, CO 80217 | Plant | Sherman. |
| Perlite (expanded): | | | |
| Lite-Weight Products Inc | 1706 Kansas Ave.<br>Kansas City, KS 66105 | do | Wyandotte. |
| Pumice and pumicite: | | | |
| Calvert Corp | Box 97<br>Norton, KS 67654 | Pit and plant | Norton. |
| Salt: | | | |
| American Salt Co | 3142 Broadway<br>Kansas City, MO 64111 | Wells and underground mine. | Rice. |
| Carey Salt Co., a division of Processed Minerals Inc. | 1800 Carey Blvd.<br>Hutchinson, KS 67501 | Underground mine | Reno. |
| Cargill Inc., Salt Div | Box 1403<br>Hutchinson, KS 67501 | Wells | Do. |

See footnotes at end of table.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN.

[2] Associate scientist, Mineral Information, Kansas Geological Survey, Lawrence, KS.

[3] Editorial assistant, Bureau of Mines, Minneapolis, MN.

## Table 6.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Salt —Continued | | | |
| Independent Salt Co | Box 36<br>Kanopolis, KS 67454 | Underground mine | Ellsworth. |
| Morton Salt Co., a division of Morton Thiokol Inc. | 110 North Wacker Dr.<br>Chicago, IL 60606 | Wells | Reno. |
| Vulcan Materials Co., Chemicals Div | Box 7689<br>Birmingham, AL 35223 | do | Sedgwick. |
| Sand and gravel: | | | |
| Construction: | | | |
| Builders Sand Co | 4150 Kansas Ave.<br>Kansas City, KS 66106 | Dredges and plants | Johnson and Wyandotte. |
| Holliday Sand & Gravel Co., a division of List & Clark Construction Co. | 6811 West 63d St.<br>Overland Park, KS 66202 | Pits and plants | Do. |
| Miles Sand Inc | 4852 North Meridian<br>Wichita, KS 67204 | Pit and plant | Sedgwick. |
| Ritchie Paving Inc | 6500 West 21st St.<br>Wichita, KS 67204 | Dredge and plant | Do. |
| Industrial: | | | |
| Holliday Sand & Gravel Co, a division of List & Clark Construction Co. | 6811 West 63d St.<br>Overland Park, KS 66202 | Pit and plant | Wyandotte. |
| HUB Materials Inc | Box 11126<br>Kansas City, KS 66111 | do | Do. |
| Stone (1983): | | | |
| Crushed: | | | |
| Limestone: | | | |
| Ash Grove Cement Co | Box 25900<br>Overland Park, KS 66225 | Quarries, underground mine, plants. | Johnson and Neosho. |
| N. R. Hamm Quarry Inc | Box 17<br>Perry, KS 66073 | Quarries and plants | Various (8 counties). |
| McAdam Limestone Products Inc. | Moran, KS 66755 | do | Anderson, Bourbon, Cowley, Linn. |
| Martin Marietta Aggregates, Central Div. | Box 30013<br>Raleigh, NC 27622 | do | Various (8 counties). |
| Midwest Minerals Inc | Box 412<br>Pittsburg, KS 66762 | do | Cherokee, Crawford, Labette, Montgomery, Neosho, Wilson. |
| Thompson-Strauss Quarries Inc., a division of Beatrice Foods Co. | 7000 Holliday Dr.<br>Kansas City, KS 66106 | Underground mine and plant. | Wyandotte. |
| Whitfield Sand & Concrete Inc | Route 4<br>Pratt, KS 67124 | Pits and plants | Pratt. |
| Sandstone: | | | |
| Quartzite Stone Co. Inc | Box 97<br>Lincoln, KS 67455 | Quarries and plant | Lincoln. |
| Dimension: | | | |
| Limestone: | | | |
| Bayer Stone Inc | 6th and Mission<br>St. Marys, KS 66536 | Quarries | Pottawatomie and Riley. |
| H. J. Born Stone Inc | Box 45<br>Silverdale, KS 67005 | do | Chase and Cowley. |
| Sulfur (recovered): | | | |
| Farmland Industries Inc | North Linden St.<br>Coffeyville, KS 67337 | Secondary recovery plant. | Montgomery. |
| Texaco Refining & Marketing Co | Box 1121<br>El Dorado, KS 67042 | do | Butler. |

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[1] Also clays.
[2] Also crushed stone.

# The Mineral Industry of Kentucky

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Kentucky Geological Survey for collecting information on all nonfuel minerals.**

**By Donald K. Harrison[1] and Garland R. Dever, Jr.[2]**

The value of Kentucky's nonfuel mineral production in 1984 was nearly $257 million, $32.5 million more than that of 1983. Crushed stone was the leading nonfuel mineral produced, accounting for more than one-half of the State's total value. The State ranked second nationally in ball clay and primary aluminum production and fourth in synthetic graphite, expanded perlite, and lime output. Other nonfuel minerals produced, in order of descending value, included portland cement, construction sand and gravel, common and fire clays, masonry cement, zinc, and industrial sand. Mineral commodities processed or manufactured but not included on table 1 included ferroalloys, exfoliated vermiculite, pig iron, steel, iron and steel slag, and regenerator iron oxides. Nationally, Kentucky ranked 28th in the value of nonfuel minerals produced in 1984.

**Table 1.—Nonfuel mineral production in Kentucky[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | [2]669 | [2]$2,142 | 802 | $7,277 |
| Gem stones | NA | 1 | NA | 1 |
| Sand and gravel: | | | | |
| Construction thousand short tons | $^{e}$5,500 | $^{e}$13,000 | 7,839 | 18,252 |
| Industrial do | 10 | 124 | W | W |
| Stone (crushed) do | 33,399 | 117,842 | $^{e}$37,300 | $^{e}$133,000 |
| Combined value of cement, clays (ball clay, fire clay, 1983), lime, zinc, and value indicated by symbol W | XX | 91,408 | XX | 98,468 |
| Total | XX | 224,517 | XX | 256,998 |

$^{e}$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball clay and fire clay; included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Kentucky, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adair | (2) | W | Stone (crushed). |
| Allen | (2) | $256 | Do. |
| Anderson | (2) | W | Do. |
| Barren | (2) | W | Do. |
| Bell | (2) | -- | |
| Boone | $1,627 | W | Stone (crushed). |
| Bourbon | (2) | W | Do. |
| Boyd | W | W | Clays. |
| Boyle | (2) | 1,063 | Stone (crushed). |
| Breckinridge | 65 | W | Do. |
| Bullitt | W | 3,629 | Stone (crushed), clays. |
| Caldwell | (2) | W | Stone (crushed). |
| Calloway | 159 | 123 | Sand (industrial). |
| Carlisle | W | W | Clays. |
| Carroll | W | (3) | |
| Carter | W | W | Stone (crushed), clays. |
| Casey | (2) | 299 | Stone (crushed). |
| Christian | (2) | W | Do. |
| Clark | (2) | -- | |
| Clinton | W | W | Stone (crushed). |
| Crittenden | (2) | W | Do. |
| Cumberland | (2) | W | Do. |
| Daviess | 1,102 | (3) | |
| Edmonson | (2) | W | Stone (crushed). |
| Estill | (2) | 389 | Do. |
| Fayette | (2) | W | Do. |
| Fleming | (2) | W | Do. |
| Floyd | (2) | W | Do. |
| Franklin | (2) | W | Do. |
| Garrard | (2) | W | Do. |
| Graves | W | W | Clays. |
| Grayson | (2) | W | Stone (crushed). |
| Green | (2) | W | Do. |
| Hancock | 227 | 227 | Clays. |
| Hardin | (2) | W | Stone (crushed). |
| Harlan | (2) | W | Do. |
| Harrison | (2) | W | Do. |
| Hart | W | W | Do. |
| Henderson | W | (3) | |
| Henry | (2) | W | Stone (crushed). |
| Jackson | (2) | 659 | Do. |
| Jefferson | 20,541 | W | Cement, stone (crushed), clays. |
| Jessamine | W | W | Stone (crushed), zinc. |
| Knott | (2) | 2 | Stone (crushed). |
| Laurel | (2) | 165 | Do. |
| Lee | (2) | W | Do. |
| Letcher | (2) | W | Do. |
| Lewis | 2 | 2 | Sand (industrial). |
| Livingston | 2,443 | W | Stone (crushed). |
| Logan | (2) | W | Do. |
| Madison | (2) | W | Do. |
| Marion | (2) | W | Do. |
| Mason | W | W | Lime, stone (crushed). |
| Meade | (2) | 4,517 | Stone (crushed). |
| Menifee | (2) | W | Do. |
| Mercer | (2) | W | Do. |
| Metcalfe | (2) | W | Do. |
| Monroe | (2) | 129 | Do. |
| Montgomery | (2) | W | Do. |
| Morgan | (2) | W | Do. |
| Muhlenberg | (2) | 2,758 | Do. |
| Nelson | (2) | W | Do. |
| Nicholas | (2) | 268 | Do. |
| Ohio | (2) | W | Do. |
| Oldham | W | 2,516 | Do. |
| Pendleton | W | W | Lime, stone (crushed). |
| Pike | (2) | W | Stone (crushed). |
| Powell | 285 | 1,593 | Stone (crushed), clays. |
| Pulaski | (2) | 2,987 | Stone (crushed). |
| Rockcastle | (2) | W | Do. |
| Scott | (2) | W | Do. |
| Simpson | (2) | W | Do. |
| Spencer | 2,348 | W | Do. |
| Taylor | (2) | W | Do. |
| Todd | (2) | W | Do. |
| Trigg | (2) | W | Do. |
| Union | W | (3) | |
| Warren | (2) | W | Stone (crushed). |
| Washington | (2) | W | Do. |
| Wayne | (2) | W | Do. |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Kentucky, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Whitley | W | W | Clays. |
| Wolfe | -- | $554 | Stone (crushed). |
| Undistributed[4] | $73,848 | 189,382 | |
| Sand and gravel (construction) | XX | [e]13,000 | |
| Stone (crushed) | [e]104,300 | XX | |
| Total | 206,947 | [5]224,517 | |

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No production of nonfuel mineral commodities was reported for counties not listed.

[2]Crushed stone was produced; data not available by county. Total State value is shown separately under "Stone (crushed)."

[3]Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Kentucky business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 3,692 | 3,713 | 3,723 |
| Total civilian labor force | do | 1,686 | 1,701 | 1,717 |
| Unemployment | do | 179 | 198 | 160 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 52.8 | 42.3 | 45.3 |
| Nonmetallic minerals except fuels[2] | do | 2.3 | 2.2 | NA |
| Coal mining | do | 46.9 | 36.7 | 39.5 |
| Oil and gas extraction[2] | do | 3.5 | 3.4 | NA |
| Manufacturing total | do | 244.8 | 242.5 | 257.8 |
| Primary metal industries | do | 16.3 | 16.3 | 18.2 |
| Stone, clay, and glass products | do | 7.7 | 7.5 | 7.7 |
| Chemicals and allied products | do | 14.1 | 13.2 | 13.4 |
| Petroleum and coal products | do | 3.9 | 4.0 | 3.9 |
| Construction | do | 50.3 | 46.6 | 49.7 |
| Transportation and public utilities | do | 65.6 | 62.7 | 64.9 |
| Wholesale and retail trade | do | 260.5 | 265.6 | 280.2 |
| Finance, insurance, real estate | do | 51.6 | 53.1 | 55.1 |
| Services | do | 216.2 | 222.9 | 232.3 |
| Government and government enterprises | do | 218.9 | 216.6 | 220.8 |
| Total | do | 1,160.7 | 1,152.3 | 1,206.1 |
| Personal income: | | | | |
| Total | millions | $33,515 | $34,604 | $38,347 |
| Per capita | | $9,077 | $9,319 | $10,300 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.4 | 39.2 | 39.2 |
| Total average hourly earnings, production workers | | $8.38 | $8.79 | $9.28 |
| Earnings by industry: | | | | |
| Farm income | millions | $1,131 | $572 | $1,344 |
| Nonfarm | do | 22,459 | $23,519 | $25,803 |
| Mining total | do | $1,789 | $1,435 | $1,637 |
| Nonmetallic minerals except fuels | do | $44 | $44 | $48 |
| Coal mining | do | $1,594 | $1,287 | $1,469 |
| Oil and gas extraction | do | $152 | $105 | $120 |
| Manufacturing total | do | $5,521 | $5,819 | $6,548 |
| Primary metal industries | do | $509 | $531 | $608 |
| Stone, clay, and glass products | do | $160 | $169 | $180 |
| Chemicals and allied products | do | $406 | $414 | $444 |
| Petroleum and coal products | do | $155 | $164 | $173 |
| Construction | do | $1,233 | $1,232 | $1,359 |
| Transportation and public utilities | do | $1,818 | $1,915 | $2,053 |
| Wholesale and retail trade | do | $3,452 | $3,631 | $3,969 |
| Finance, insurance, real estate | do | $961 | $1,083 | $1,197 |
| Services | do | $3,613 | $4,042 | $4,439 |
| Government and government enterprises | do | $3,974 | $4,254 | $4,482 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 7,587 | 11,839 | 12,510 |
| Value of nonresidential construction | millions | $316.3 | $392.2 | $451.0 |
| Value of State road contract awards | do | $225.5 | $452.2 | $318.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 954 | 889 | 1,054 |

See footnotes at end of table.

**Table 3.—Indicators of Kentucky business activity —Continued**

| | 1982$^{r}$ | 1983 | 1984$^{p}$ |
|---|---|---|---|
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $206.9 | $224.5 | $257.0 |
| Value per capita | $56 | $60 | $69 |

$^{p}$Preliminary. $^{r}$Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

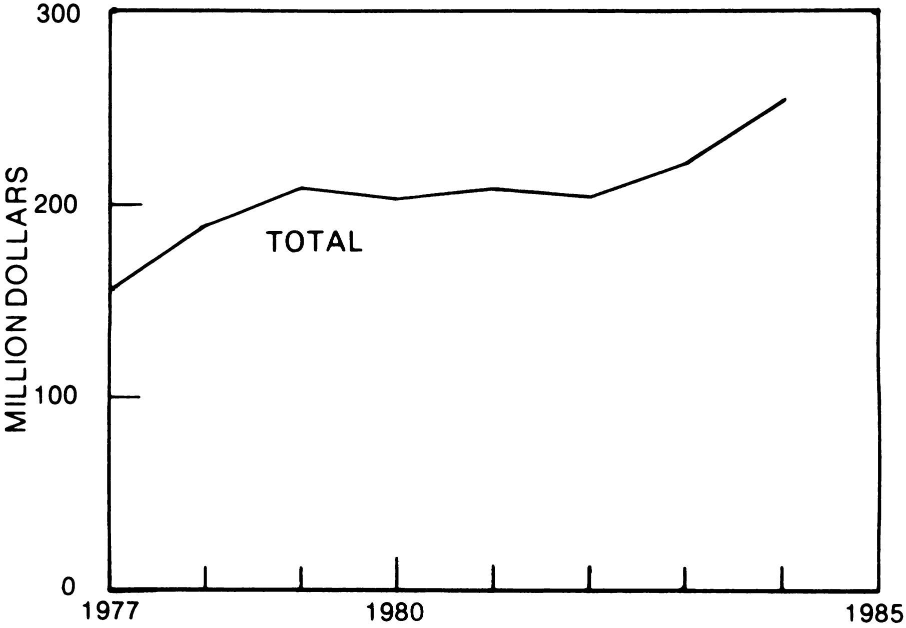

Figure 1.—Total value of nonfuel mineral production in Kentucky.

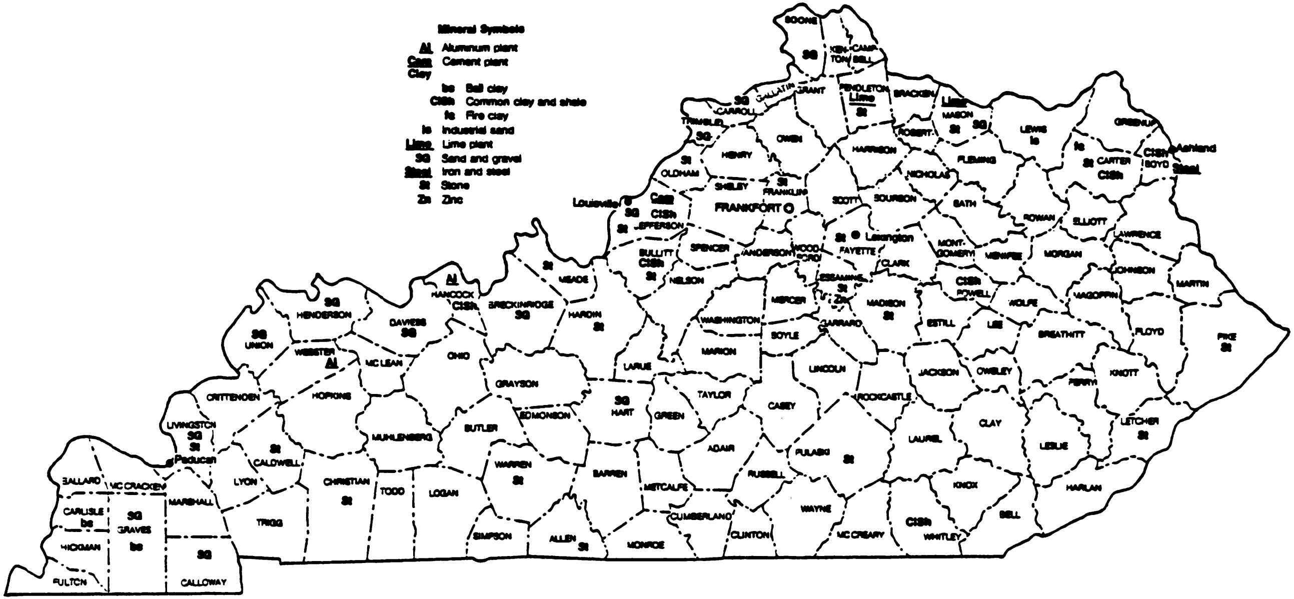

Figure 2.—Principal mineral producing localities in Kentucky.

**Trends and Developments.**—Two mineral-related issues in the State during the year concerned acid rain problems and the development of the State's synthetic fuels plants. Although several synfuel projects were still struggling to survive at yearend, many projects were abandoned or put on hold as the result of the continuing drop in world oil prices coupled with inactivity of the U.S. Synthetic Fuels Corp., a Government agency that subsidized projects involving alternative energy sources. In addition, the State's synthetic fuels program received a setback near yearend when the Kentucky Board of Energy Research announced it would no longer fund the synthetic fuels pilot plants. The board oversees the State's Energy Development and Demonstration Trust Fund, created in 1974 with legislative authority to commit $55 million of State money to energy projects by yearend 1985.

The State, which by yearend had invested nearly $28 million primarily in synfuel pilot plants, redirected its emphasis from synthetic fuels to coal-burning research to control acid rain. In 1984, the Kentucky Board of Energy Research obligated $10 million for participation in the construction of a new $220 million, 160-megawatt atmospheric fluidized bed combustion (AFBC) facility at the Tennessee Valley Authority's Shawnee plant near Paducah. The AFBC facility would allow use of higher sulfur coal to be burned cleanly and efficiently, thus eliminating expensive air pollution control equipment. In an AFBC boiler, crushed coal is mixed with limestone and burned while suspended by air forced through the bed of the boiler. The limestone absorbs most of the sulfur dioxide and other pollutants from the flue gas before it leaves the boiler.

Development of AFBC technology was expected to spur the use of western Kentucky high-sulfur coal. It would also greatly expand the use of the State's limestone resources, since about 1 short ton of limestone is mixed in the boiler with every 3 tons of coal used. In general, the limestone-to-coal ratio is dependent upon sulfur content of the coal and amount of sulfur emissions to be captured. Site preparation of the Paducah facility was expected to begin in the summer of 1985, with the plant expected to come on-line in 1988. Although AFBC will be a major focus for the Board of Energy Research in 1985, the agency was also increasing research efforts into various coal cleaning and coal preparation methods.

Kentucky in 1984 again retained its rank as the top coal producing State in the Nation, accounting for nearly one-fifth of the total U.S. output. Production totaled 159.3 million short tons, based on U.S. Department of Energy data, up from 131.5 million tons in 1983. The growth reflected an increased demand by the utility market, partly in anticipation of a possible United Mine Workers of America strike. Kentucky was also a major exporter of bituminous coal, which was the State's principal mineral export in 1984.

In 1984, Kentucky ranked sixth nationally in terms of new manufacturing plants and expansions according to a report published by Conway Data of Atlanta, GA.[3] In 1984, total investments in new plants and expansions were more than $1 billion and created more than 22,000 new jobs in the State. Investments in new and expanded manufacturing plants related to mining or mineral processing in Kentucky during the year totaled $209.7 million and are summarized in table 4.

**Table 4.—Kentucky: Mineral-related investments in 1984**

| Commodity | New | | | Expansions | | |
|---|---|---|---|---|---|---|
| | Number of plants | Employment | Investment (thousands) | Number of plants | Employment | Investment (thousands) |
| Fabricated metal products | 11 | 519 | $42,126 | 47 | 1,431 | $65,181 |
| Primary metals | 3 | 250 | 1,000 | 18 | 485 | 55,063 |
| Stone, clay, and glass products | 6 | 189 | 10,750 | 21 | 601 | 35,580 |
| Total | 20 | 958 | 53,876 | 86 | 2,517 | [1]155,825 |

[1]Data do not add to total shown because of independent rounding.

Source: Kentucky Commerce Cabinet. Kentucky Manufacturing Developments in 1984, Frankfort, KY.

The State continued to lead the Nation in the apparent consumption of industrial explosives and blasting agents in 1984. Nearly 1 billion pounds was sold, primarily utilized by the coal mining industry. The State ranked second in sales for quarrying and nonmetal mining with nearly 46.5 million pounds sold for this use.

**Legislation and Government Programs.**—In 1984, a number of bills were signed into law concerning coal mining in the State. One significant bill, House Bill (H.B.) 514, contained the statutory amendments to the State's surface coal mining law, which were needed for Kentucky to attain full "primacy." The bill made the State's strip mining law mirror the Federal Surface Mining and Reclamation Act of 1977. Although H.B. 514 was opposed by the coal industry, the changes were demanded by the U.S. Office of Surface Mining, which oversees Kentucky's enforcement of the Federal act.

Other bills concerning mineral resources and signed into law in 1984 included H.B. 93, which exempts fluorspar, lead, zinc, barite, and tar sands from the State's 4.5% severance tax on the gross value of natural resources. The law also allowed a credit against the severance tax to the preducer that mines limestone or processes limestone through the riprap construction aggregate or agricultural limestone stages, and that sells in interstate commerce not less than 60% of such limestone.

In February, the Governor signed into law H.B. 32, the "broad-form deed bill." Under H.B. 32, mining methods, such as strip mining, that were not in use at the time when the broad-form deeds were signed (generally during the early part of this century) cannot be used by coal operators unless they obtain the permission of the current surface-land owners or unless they show evidence that signers of the deed intended for such methods to be used. Constitutionality of the law was expected to be tested in the courts.

Also during the year, the Kentucky Department of Vehicle Regulation issued a regulation dealing with the transport of building materials to road construction projects. The regulation allowed up to 80,000 pounds to be hauled to a road project across any public highway, provided axle weight limits and dimensional limits were met. In addition, the hauler must obtain written notification from the district engineer attesting to the capacity of every bridge or structure along the proposed haulage route.

The Kentucky Geological Survey (KGS), established in 1854, continued to evaluate and investigate the State's mineral resources. During 1984, the KGS continued investigating the sand and gravel deposits along the Ohio River Valley for sources of construction aggregate. The KGS also participated in the Midcontinent Strategic and Critical Minerals Program sponsored by the U.S. Geological Survey (USGS). Other ongoing projects involving nonfuel mineral resources concerned zinc mineralization in the south-central part of the State and investigations of limestone and dolomite resources for coal-related uses.

During 1984, 10 new publications were issued by the KGS. These included a folio of geologic cross sections and columnar sections, which shows the general stratigraphic and structural framework for individual areas throughout the State; a study of reflectance and rank of coals in eastern Kentucky; an oil and gas drilling activity summary for 1983; geologic descriptions and coal analyses for cores drilled in the Daniel Boone National Forest; proceedings of the 1981 meeting of the Kentucky Oil & Gas Association; and a generalized oil and gas map of Kentucky. Five open file reports (OFR) were also released during the year. Two of the OFR's concerning the State's nonfuel minerals were an evaluation of the Tabb area in the western Kentucky fluorspar district and a cross section prepared as part of an investigation to determine the potential for the occurrence of strategic and critical minerals in the western part of the State.[4]

During the year, the USGS released a new 1:1,000,000 map entitled "Aeromagnetic Map of Tennessee and Kentucky." The USGS also published nine new 1:100,000 topographic maps covering sections of Kentucky. Sheets published included Beaver Dam, Beckley, Corbin, Elizabethtown, Hazard, Irvine, Madisonville, Somerset, and Williamson. Publication of these 9 maps brought the total number of published 1:100,000 topographic maps in Kentucky to 16.

In July, the U.S. Bureau of Mines made an allotment grant to the Institute for Mining and Minerals Research at the University of Kentucky, Lexington. The allotment was part of the mineral institute's program created under title III of Public Law 95-87. To receive the allotment, the school had to match the Federal funds with grants from non-Federal sources. The authorization for the mineral institute program was extended through fiscal year 1989 after the President signed Public Law 98-409. Research activities associated with the grants at the University of Kentucky included both surface and underground mining, reclamation, exploration, characterization, and legal issues. Technology transfer occurred through short courses and conferences on both a State and national basis.

In fiscal year 1984, the U.S. Bureau of Mines had two active contracts and grants in the State totaling $638,535. The largest grant, more than $500,000, was awarded to the University of Kentucky for studies related to development and field testing methods of mine health and safety skills.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

Increases in both quantity and value were reported for cement, clays, lime, sand and gravel, and stone. These increases in industrial minerals were largely attributable to the increase in housing starts and construction activity during the year.

**Cement.**—Kosmos Cement Co. Inc., a subsidiary of Moore McCormack Cement Inc., operated the State's only cement plant at Kosmosdale, Jefferson County, near Louisville. The coal-fired, dry-process plant, which has an annual grinding capacity of 670,000 short tons, produced both portland and masonry cement. In 1984, combined shipments and value of portland and masonry cement were higher than that of 1983 by 29% and 35%, respectively. During the year, the company increased its limestone reserves to 55 million tons by purchasing property with an additional 18 million tons. Kosmos mined limestone for cement manufacture at Battletown, Meade County, approximately 28 miles from the plantsite, and shipped the stone by barge to the plant.[5]

**Clays.**—In 1984, 13 companies produced common clay and shale, fire clay, and ball clay from 19 pits. Common clay was produced by 10 companies at 12 pits in Boyd, Bullitt, Carter, Hancock, Jefferson, Powell, and Whitley Counties. Although output of common clay dropped only 1% in 1984, value increased nearly 18%. Principal uses were for the production of common and face brick, cement lightweight aggregate for use in manufacturing, concrete block, and structural concrete products.

Fire clay was mined by one company, Burchett Clay Co., in Carter County. The fire clay was used primarily for fire brick and block. Ball clay, primarily used by the ceramic industry for bonding, was produced by two companies at three operations in Carlisle and Graves Counties. Principal ball clay markets are ceramics (mainly dinnerware), pottery, wall tile, and sanitary ware.

During the year, Hecla Mining Co. acquired Ranchers Exploration and Development Corp. and, as a result, acquired Ranchers' wholly owned subsidiary, Kentucky-Tennessee Clay Co. (K-T). K-T was purchased by Ranchers in 1983 after the company acquired more than 50% of K-T's outstanding stock.

**Fluorspar.**—Although no fluorspar production has been reported since 1978, several companies conducted limited exploratory drilling in the western Kentucky fluorspar district, which is part of the Illinois-Kentucky fluorspar district. Prior to World War II, Kentucky ranked either first or second in the Nation in annual fluorspar production, with the No. 1 position switching back and forth between Kentucky and Illinois. During that time, more than 2,000 workers were employed in Kentucky in the mining and processing of this mineral commodity.

**Gem Stones.**—Gem material and mineral specimens have been collected in various parts of the State. The State is well known for its Halls Gap millerite and honessite, agate, and coalfield fossils. Some of the other minerals found in the State included barite, calcite, chalcopyrite, fluorite, galena, pyrite, and sphalerite.

**Graphite (Synthetic).**—Three companies produced synthetic graphite in 1984, one more than in 1983. Superior Graphite Co. produced graphite powder at Hopkinsville, Christian County, for use as an additive in ironmaking. Sigri Carbon Corp. produced graphite electrodes at a plant in Hickman, Fulton County. In late 1984, the Ashland Petroleum Co. brought on-stream a 30-short-ton-per-year capacity, high-modulus graphite fiber plant at Catlettsburg, Boyd County. Capacity of the plant was expected to be increased to 300 tons per year by 1986.

**Lime.**—In 1984, Kentucky continued to rank fourth of 38 States producing lime in the United States. Two companies each operated an underground mine to preduce feed for on-site calcining facilities. Both output and value increased 9% and 7%, respectively, compared with that of 1983.

Dravo Lime Co., a subsidiary of Dravo Corp., operated a 1-million-short-ton-per-year capacity plant at Maysville, Mason County. The plant, the second largest in the Nation in terms of total output, produced patented Thiosorbic lime, a scrubbing reagent for removal of sulfur dioxide from stack gases of coal-burning powerplants. Most of the plant's output was committed under long-term contracts to 14 electric utility generating units in the Ohio River Valley region. In anticipation of more stringent regulations to limit $SO_2$ emissions, the company continued to plan for an additional kiln at Maysville late in the decade. If a new kiln is added, it would increase the plant's capacity by one-third. Development work on other lime-based systems to control emissions from high-sulfur coal was also under way.

The Black River Lime Co. produced both quicklime and hydrated lime at the Nation's fourth largest plant at Carntown, Pendleton County. The lime was principally sold for industrial and chemical use in the Midwest and upper South.

**Perlite (Expanded).**—In 1984, Kentucky ranked fourth of 32 States producing expanded perlite. Two companies expanded crude perlite shipped in from out of State. International Permalite Co. operated a plant at Florence in Boone County and W. R. Grace & Co. at Wilder in Campbell County. Both output and value increased substantially in 1984, the result of International Permalite attaining full production. The company had purchased the plant in 1983. Most of the perlite was used for roof insulation board, as a horticultural aggregate, and oil absorbent.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of construction sand and gravel increased nearly 43% in 1984 compared with 1983 levels reflecting increased contract construction in residential, nonresidential, and public projects.

In 1984, 21 companies mined construction sand and gravel at 27 operations in 17 counties. Leading counties in order of output were Daviess, Livingston, Trimble, Boone, and Carroll. Main uses for the material were for concrete aggregate, asphaltic concrete, and road base and coverings.

Controversy continued during the year on a proposed sand mining operation next to some historic Indian mounds on the Ohio River in Greenup and Lewis Counties. The proposed mining operation by the Shaffer Co. is on a 69-acre tract near the Portsmouth Earth Works, which has been placed on the National Register of Historic Places because of its archaeological significance. Although the State Natural Resources and Environmental Cabinet gave the permit application preliminary approval in November 1983, the issue was still not settled at yearend 1984.

**Table 5.—Kentucky: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 2,514 | $5,642 | $2.24 |
| Concrete products | W | W | 4.88 |
| Asphaltic concrete | 539 | 1,459 | 2.71 |
| Road base and coverings | 214 | 654 | 3.06 |
| Fill | W | W | 2.14 |
| Other | 4,571 | 10,497 | 2.30 |
| Total or average | [1]7,839 | 18,252 | 2.33 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Data do not add to total shown because of independent rounding.

*Industrial.*—One company mined industrial sand in the State in 1984. Industrial Supply House of Greenup Inc. produced silica sand from an operation in Lewis County. Principal uses were for mold and core and sandblasting.

**Slag—Iron and Steel.**—One company processed slag produced by the State's iron and steel industry. The Heckett Co. processed both air-cooled iron (blast furnace) slag and steel (basic oxygen furnace) slag at a plant in Ashland, Boyd County. The company also processed steel slag produced by electric arc furnaces at Owensboro, Daviess County.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Based on preliminary estimates, 37.3 million short tons of stone was produced valued at $133 million. Value of the total crushed stone produced accounted for more than one-half of the State's total. Both limestone and sandstone were produced, with limestone accounting for the majority of the production. Major uses for the crushed stone were for road base, road base aggregate, and riprap.

During 1984, the Kentucky Transportation Cabinet Division of Materials approved material from 18 limestone sources for use in experimental skid-resistant pavements. The Transportation Cabinet Division also approved one limestone source for general uses. This approval means that material from this source may also be used on Federal-aid projects as well as State projects under specified conditions.

**Vermiculite (Exfoliated).**—W. R. Grace exfoliated crude vermiculite mined in other States at its plant in Wilder, Campbell County. The product was used primarily in loose fill and block insulation, fireproofing, lightweight aggregate, and soil conditioning.

## METALS

**Aluminum.**—Kentucky ranked second, behind Washington, in primary aluminum production in 1984. Two companies each operated smelters in the State; National-Southwire Aluminum Co. operated a 190,000-short-ton-per-year plant in Hawesville, Hancock County, and Alcan Aluminum Ltd. operated a 180,000-short-ton-per-year smelter in Sebree, Webster County. National-Southwire's plant was upgraded by 10,000 tons per year to 190,000 tons through implementation of energy utilization techniques that enhanced productivity.[6]

In October, final approval was given by the U.S. Department of Justice on the sale of part of the Atlantic Richfield Co. (ARCO) aluminum facilities to Alcan. In June, the Justice Department had intervened in the sale because of possible antitrust law violations. Earlier in the year, the companies had announced an agreement for Alcan to purchase ARCO's Sebree smelter; a new $450 million can stock-rolling facility in Logan County; the packaging products plant, laminating plant, and rolling mill in Louisville; a rolling mill in Terre Haute, IN; and a 25% interest in the Aughinish, Ireland, aluminum refinery. Under terms of the agreement, the Justice Department allowed ARCO to proceed with the sale but limited Alcan's ownership and management of the Logan County mill to 40%, with ARCO retaining a 60% share. Either company will be able to sell its share to a third party, provided that party is not one of the three top U.S. aluminum producers. The Logan County plant produces sheet for aluminum cans, for which there is a highly concentrated U.S. market (88% of total U.S. 1983 sales were made by four producers).

During the year, both primary aluminum companies served by Big Rivers Electric Corp. expressed concern over the utility's proposal to raise rates about 20% over the next 3 years. National-Southwire announced that it might be forced to shut down its smelter in Hawesville if the rate hikes go into effect, and Alcan said that the proposed rate increase was a potentially "crippling" situation for aluminum smelters trying to compete in the world market. Ironically, National-Southwire and Alcan smelters consume about 75% of the power supplied by the utility company. Other aluminum firms included in the utility's service are a secondary smelter and rolling mill operated by Barmet Industries Inc., Livia; a rolling mill in Hawesville owned by Alumax Inc.; and the Lewisport rolling mill, which was sold at yearend by Martin Marietta Corp. to Conalco Ltd. of Melbourne, Australia.

**Ferroalloys.**—SKW Alloys Inc. continued to produce ferroalloys at its plant in Calvert City, Marshall County. The Calvert City plant is one of two facilities operated by SKW, which produced 50% and 75% ferrosilicon. The plant also produced blocking chrome and silicomanganese. In 1984, the company reopened the plant utilizing management personnel after a strike in September 1983 shut the plant down. At yearend, the labor issue remained unsolved.

**Iron and Steel.**—Armco Inc., the nation's sixth largest steel producer, operated two blast furnaces and two basic oxygen furnaces (BOF) at its integrated mill in Ashland, Boyd County. Both pig iron and carbon and low-alloy steel were produced at the plant. The company also operated a six-strand continuous caster, which has the capacity to produce 720,000 short tons per year of carbon and alloy blooms. Regenerator iron oxides were also produced at the plant. During 1984, the company considered plans to construct a second caster that would bring the continuous casting capability at Ashland to 100% capacity.

In addition to Armco's integrated mill, three companies operated minimills and one operated a specialty mill in the State. Companies operating minimills were Newport Steel Corp., Newport, Campbell County; Kentucky Electric Steel Co., Ashland, Boyd County; and Ohio River Steel Corp. at Calvert City, Marshall County. Green River Steel Corp. operated a specialty steel mill in Owensboro.

During the year, Newport renewed plans for a new $28 million welded pipe mill at Newport that had been delayed because of a severe drop in demand for pipe in 1982 and 1983. The mill would increase Newport's welded pipe capacity from 180,000 to 580,000 tons per year and would allow the company to produce larger size pipe.

In late December, Green River Steel indefinitely laid off 138 production employees at the Owensboro plant, the result of a slump in sales of its carbon and alloy steels. Green River Steel produced specialty steel in the form of bars, billets, and blooms, which it sold to the aerospace industry and to manufacturers of heavy, off-road equipment. According to the company, sales to the latter had dropped substantially, necessitating the layoffs.

**Zinc.**—Lexington Quarry Co. (Catnip Hill operation), Jessamine County, continued to recover and concentrate zinc ore as a byproduct of underground limestone mining. The zinc ore (sphalerite) occurs in a narrow vein deposit in the limestone. The zinc concentrate was shipped to an out-of-State smelter. Both output and value were up substantially over 1983 levels.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] Head, Industrial and Metallic Minerals Section, Kentucky Geological Survey, Lexington, KY.

[3] Kentucky Commerce Cabinet (Frankfort, KY). Kentucky Manufacturing Developments in 1984. 1985, 20 pp.

[4] Trace, R. D. Geology and Ore Deposits of the Tabb Area, Tabb Fault System, Crittenden and Caldwell Counties. KY Geol. Surv. Open File Rep., 1984, 88 pp.

Anderson, W. H. Phanerozoic Cross Section Along 88 Degrees Longitude, Western Kentucky. KY Geol. Surv. Open File Rep., 1984.

[5] Moore McCormack Resources Inc. Securities and Exchange Commission Form 10-K Report, 1984. p. 2.

[6] American Metal Market. Aluminum Smelt Rate at 81.7%. V. 92, No. 33, Feb. 16, 1984, p. 7.

## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum (primary): | | | |
| Alcan Aluminum Ltd | Sebree, KY 42555 | Smelter | Webster. |
| National-Southwire Aluminum Co. | Box M<br>Hawesville, KY 42348 | do | Hancock. |
| Cement: | | | |
| Kosmos Cement Co. Inc.,[1] a subsidiary of Moore McCormack Cement Inc. | Box 72319<br>Louisville, KY 40272 | Plant | Jefferson. |
| Clays: | | | |
| Ball clay: | | | |
| Kentucky-Tennessee Clay Co | Box 449<br>Mayfield, KY 42066 | Mines and plant | Carlisle and Graves. |
| Old Hickory Clay Co | Box 66<br>Hickory, KY 42051 | do | Graves. |
| Common clay: | | | |
| General Shale Products Co | Box 3547 CRS<br>Johnson City, TN 37602 | Mine and plant | Jefferson. |
| Kentucky Solite Corp | Box 27211<br>Richmond, VA 23261 | do | Bullitt. |
| U.S. Brick Inc., Sipple Div | Box 567<br>Stanton, KY 40380 | do | Powell. |
| Fire clay: | | | |
| Burchett Clay Co | Route 1, Box 850<br>Olive Hill, KY 41164 | Mine | Carter. |
| Ferroalloys: | | | |
| SKW Alloys Inc | Box 217<br>Calvert City, KY 42029 | Plant | Marshall. |
| Graphite (synthetic): | | | |
| Sigri Carbon Corp | Box 229<br>Hickman, KY 42050 | do | Fulton. |
| Superior Graphite Co | Box 535<br>Hopkinsville, KY 42240 | do | Christian. |
| Iron and steel (pig iron): | | | |
| Armco Inc | Middletown, OH 45202 | Plant | Boyd. |
| Newport Steel Corp | 9th & Lowell Sts.<br>Newport, KY 41072 | Plants | Campbell. |
| Lime: | | | |
| Black River Lime Co | Route 1<br>Butler, KY 41006 | Mine and plant | Pendleton. |
| Dravo Lime Co., a subsidiary of Dravo Corp.[2] | 3600 Neville Rd.<br>Pittsburgh, PA 15225 | do | Mason. |
| Perlite (expanded): | | | |
| W. R. Grace & Co.[3] | 62 Whittemore Ave.<br>Cambridge, MA 02140 | Plant | Campbell. |
| International Permalite Co | 300 North Haven Ave.<br>Ontario, CA 91764 | do | Boone. |
| Sand and gravel: | | | |
| Construction: | | | |
| Daviess County Sand & Gravel Co. | Rural Route 1, Box 28<br>Owensboro, KY 42301 | Dredge | Daviess. |
| Evansville Materials Inc | Box 249<br>Tell City, IN 47586 | do | Do. |
| Ingram Materials Inc | 10 Fatherland St.<br>Nashville, TN 37213 | do | Livingston. |
| Martin Marietta Corp.[2] | Box 30013<br>Raleigh, NC 27622 | Pits | Carroll, Jefferson, Oldham. |
| Nugent Sand Co. Inc | Box 6072<br>1833 River Rd.<br>Louisville, KY 40206 | Dredges | Oldham and Trimble. |
| Industrial: | | | |
| Industrial Supply House of Greenup Inc. | Box 647, 422 Harrison St.<br>Greenup, KY 41144 | Pit | Lewis. |
| Stone (crushed, 1983): | | | |
| Kentucky Stone Corp | 400 Sherburn Lane<br>Louisville, KY 40207 | Underground mines, quarries, plants. | Various. |
| Reed Crushed Stone Co | Box 35<br>Gilbertsville, KY 42044 | Quarry and plant | Livingston. |
| Three Rivers Rock Co | Box 218<br>Smithland, KY 42081 | do | Do. |
| Zinc: | | | |
| Lexington Quarry Co.[2] | 2200 Catnip Hill Rd.<br>Nicholasville, KY 40356 | Underground mine and plant. | Jessamine. |

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[1] Also clays and stone.
[2] Also stone.
[3] Also exfoliated vermiculite.

# The Mineral Industry of Louisiana

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Louisiana Geological Survey for collecting information on all nonfuel minerals.**

**By James R. Boyle[1] and Charles G. Groat[2]**

The value of Louisiana's nonfuel mineral production in 1984 was $511.5 million, an increase of $64.7 million over that of 1983. However, the value of 1984 output was still below the record year of 1980 when the value was $583.8 million. Although increased output of most minerals occurred, an increase in unit prices also contributed to the increased value of nonfuel minerals. The State led the Nation in salt output, was second in Frasch sulfur output, and was sixth in the production of recovered elemental sulfur from oil refineries. The combined value of salt and Frasch sulfur remained the major portion of the State's total nonfuel minerals value in 1984. Output of minerals used mainly in the construction industry increased slightly, paralleling construction activities. Louisiana ranked 16th nationally in value of nonfuel minerals produced.

**Trends and Developments.**—The State's economic advance started late in 1983 and continued through midyear 1984. At that time, the economy weakened and remained weak throughout the rest of 1984. The performance of the economy was linked to weaknesses in the energy, petrochemical, and international trade sectors; employment declined in these sectors in 1984. Weaknesses in these sectors were also responsible for the slack in construction activ-

**Table 1.—Nonfuel mineral production in Louisiana[1]**

| Mineral | | 1983 | | 1984 | |
|---|---|---|---|---|---|
| | | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays | thousand short tons | [2]505 | $10,793 | 547 | [2]$10,858 |
| Gem stones | | NA | 1 | NA | 1 |
| Salt | thousand short tons | 11,544 | 100,936 | 13,101 | 112,142 |
| Sand and gravel: | | | | | |
| Construction | do | [e]14,200 | [e]46,600 | 17,040 | 54,664 |
| Industrial | do | 291 | 4,252 | 266 | 3,757 |
| Stone (crushed) | do | 5,758 | 25,702 | [e]4,100 | [e]19,500 |
| Sulfur (Frasch) | thousand metric tons | 1,643 | W | 2,007 | W |
| Combined value of cement, clays (bentonite, 1984), gypsum, lime, and values indicated by symbol W | | XX | 258,477 | XX | 310,548 |
| Total | | XX | 446,761 | XX | 511,470 |

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes bentonite; 1984 value included with "Combined value" figure.

### Table 2.—Value of nonfuel mineral production in Louisiana, by parish[1]

(Thousands)

| Parish | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Allen | W | W | Sand (industrial). |
| Ascension | $3,828 | $6,250 | Salt. |
| Assumption | W | W | Do. |
| Beauregard | W | (2) | |
| Bienville | W | W | Clays. |
| Caddo | W | W | Do. |
| Calcasieu | W | W | Salt. |
| Cameron | W | W | Do. |
| Catahoula | 308 | -- | |
| Claiborne | W | 219 | Clays. |
| East Baton Rouge | W | 1,234 | Sand (industrial). |
| East Feliciana | 1,581 | (2) | |
| Grant | W | (2) | |
| Iberia | 60,801 | W | Salt. |
| Iberville | W | W | Do. |
| Jefferson | W | W | Sulfur, salt. |
| Jefferson Davis | W | (2) | |
| Lafayette | W | (2) | |
| La Salle | 2,575 | (2) | |
| Livingston | 782 | (2) | |
| Natchitoches | W | W | Clays. |
| Orleans | W | 61,489 | Cement, lime, stone (crushed). |
| Ouachita | 1,333 | (2) | |
| Plaquemines | W | W | Sulfur, salt. |
| Pointe Coupee | W | W | Clays. |
| Rapides | 5,944 | (2) | |
| Red River | 396 | 226 | Sand (industrial). |
| Sabine | 3 | (2) | |
| St. Bernard | 501 | (2) | |
| St. Helena | W | W | Clays. |
| St. Martin | W | W | Salt. |
| St. Mary | W | 26,319 | Salt, lime, stone (crushed). |
| St. Tammany | W | W | Clays. |
| Tangipahoa | W | (2) | |
| Terrebonne | W | W | Sulfur, salt. |
| Union | 254 | (2) | |
| Vermilion | 252 | (2) | |
| Vernon | 1,346 | (2) | |
| Washington | 3,634 | (2) | |
| Webster | W | W | Sand (industrial). |
| West Feliciana | 1,453 | (2) | |
| Winn | W | W | Gypsum, stone (crushed). |
| Undistributed[3] | 332,677 | 304,424 | |
| Sand and gravel (construction) | XX | [e]46,600 | |
| Stone (crushed) | W | XX | |
| Total | [4]417,667 | 446,761 | |

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for parishes not listed.

[2] Construction sand and gravel was produced; data not available by parish. Total State value is shown separately under "Sand and gravel (construction)."

[3] Includes gem stones that cannot be assigned to specific parishes and values indicated by symbol W.

[4] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Louisiana business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 4,383 | 4,440 | 4,462 |
| Total civilian labor force | do. | 1,863 | 1,913 | 1,940 |
| Unemployment | do. | 193 | 225 | 194 |
| Employment (nonagricultural): | | | | |
| Mining total | do. | 95.9 | 80.7 | 81.1 |
| Nonmetallic minerals except fuels | do. | 3.6 | 3.2 | 3.1 |
| Oil and gas extraction | do. | 92.3 | 77.5 | 78.0 |
| Manufacturing total | do. | 202.6 | 180.1 | 181.9 |
| Primary metal industries | do. | 5.8 | 3.7 | 3.6 |
| Stone, clay, and glass products | do. | 7.5 | 7.7 | 8.1 |
| Chemicals and allied products | do. | 33.6 | 30.3 | 29.1 |
| Petroleum and coal products | do. | 13.6 | 13.1 | 13.0 |
| Construction | do. | 123.0 | 115.2 | 118.8 |
| Transportation and public utilities | do. | 128.5 | 118.2 | 118.1 |
| Wholesale and retail trade | do. | 367.7 | 369.4 | 380.9 |
| Finance, insurance, real estate | do. | 79.9 | 82.0 | 83.1 |
| Services | do. | 302.1 | 304.6 | 312.1 |
| Government and government enterprises | do. | 307.3 | 315.0 | 320.6 |
| Total | do. | 1,607.0 | 1,565.2 | [1]1,596.7 |
| Personal income: | | | | |
| Total | millions | $43,910 | $45,368 | $48,233 |
| Per capita | | $10,019 | $10,218 | $10,808 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 41.0 | 40.0 | 41.6 |
| Mining | | 45.1 | 46.2 | 46.9 |
| Total average hourly earnings, production workers | | $9.36 | $9.79 | $10.06 |
| Mining | | $10.28 | $11.29 | $11.22 |
| Earnings by industry: | | | | |
| Farm income | millions | $378 | $462 | $615 |
| Nonfarm | do. | $32,493 | $32,588 | $34,565 |
| Mining total | do. | $3,143 | $2,660 | $2,791 |
| Nonmetallic minerals except fuels | do. | $86 | $79 | $85 |
| Oil and gas extraction | do. | $3,053 | $2,577 | $2,702 |
| Manufacturing total | do. | $5,306 | $4,984 | $5,286 |
| Primary metal industries | do. | $176 | $119 | $115 |
| Stone, clay, and glass products | do. | $163 | $175 | $193 |
| Chemicals and allied products | do. | $1,212 | $1,155 | $1,199 |
| Petroleum and coal products | do. | $596 | $639 | $686 |
| Construction | do. | $2,978 | $2,891 | $2,955 |
| Transportation and public utilities | do. | $3,267 | $3,243 | $3,365 |
| Wholesale and retail trade | do. | $5,272 | $5,369 | $5,736 |
| Finance, insurance, real estate | do. | $1,438 | $1,636 | $1,764 |
| Services | do. | $5,640 | $6,067 | $6,656 |
| Government and government enterprises | do. | $5,337 | $5,623 | $5,884 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 20,332 | 33,867 | 26,865 |
| Value of nonresidential construction | millions | $1,183.7 | $1,209.5 | $1,214.4 |
| Value of State road contract awards | do. | $473.0 | $390.0 | $502.2 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 2,520 | 2,564 | 2,730 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $417.7 | $446.8 | $511.5 |
| Value per capita | | $95 | $101 | $115 |

[p] Preliminary. [r] Revised.

[1] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

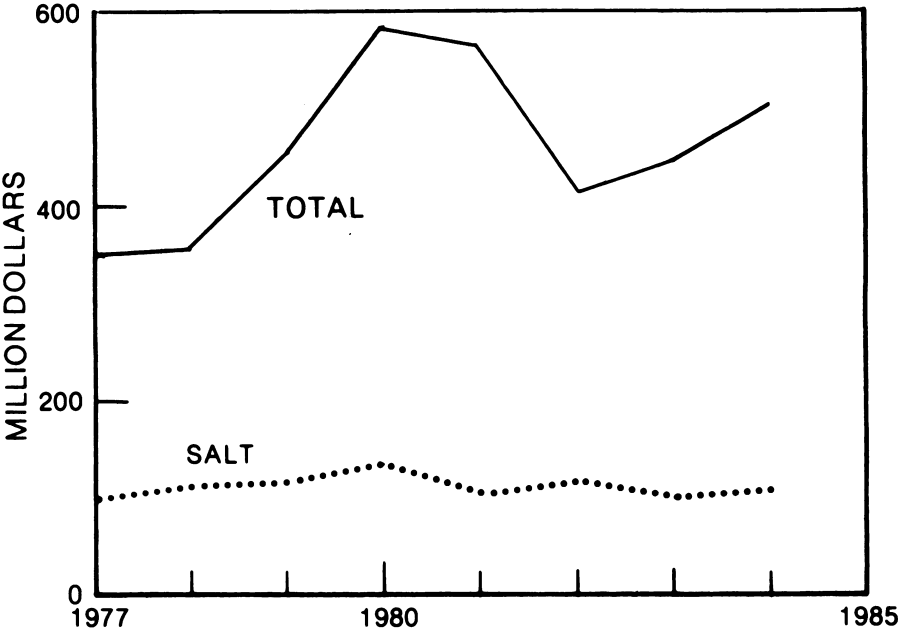

Figure 1.—Value of salt and total value of nonfuel mineral production in Louisiana.

ity. Construction activities peaked in 1981, and since then, about 30,000 jobs have been lost; actions in the construction industry severely impacted on the construction aggregate industry. Construction employment remained constant until September, then dropped for the rest of the year, resulting in lower employment at yearend 1984 than at yearend 1983. Nonmetallic mining and primary metals employment decreased slightly during 1984.[3]

Severance tax receipts for 1984, as reported by the Louisiana Department of Revenue, totaled $3.6 million. Minerals included in the tax were brine ($50,000), gravel ($424,000), salt ($322,000), sand ($506,000), shell ($262,000), stone ($18,000), and sulfur ($2.0 million). Severance taxes, along with lease and royalty income, provide for roughly one-half of all State revenues. The severance tax for shell, sand, and gravel was increased to 6 cents per short ton in August.

Waterborne imports handled by the Port of New Orleans in 1984 included iron and steel (3.4 million tons), gypsum and limestone (690,000 tons), ferroalloys (520,000 tons), and smaller amounts of bauxite, manganese ores, nickel matte, zinc ores, and other nonferrous ores. In addition, small amounts of abrasives, clays, gravel, mica, pyrites, and salt were also imported. Exports of minerals included coal (3.5 million tons), coke (944,000 tons), manufactured fertilizers (520,000 tons), clays (60,000 tons), and ferroalloys (31,000 tons). Small amounts of abrasives, gypsum, quartz, salt, sand and gravel, and sulfur were also exported through the Port of New Orleans. The total of 3.4 million tons of iron and steel exports was 121% higher than that of 1983.

During 1984, 636,000 tons of cement was imported through New Orleans from Canada, Colombia, France, Mexico, Spain, and Venezuela; Canada and Mexico accounted for 62% of the imports of cement. Imports of cement increased 386% over that of 1983.

The port at Burnside handled predominantly minerals during 1984. The facilities handled 4.1 million tons of material during fiscal year 1984, up from 3.4 million tons in 1983. Of the total 4.1 million tons, 3.4 million tons was imports and 700,000 tons, mainly coal and coke, was exports. The port handled about 700,000 tons of bauxite for the nearby Ormet Corp. and an additional 200,000 tons of bauxite and 550,000 tons of alumina for others. In order of tonnage, other imports included fertilizers (350,000 tons) and metallic ores (860,000 tons), which were iron ore, manganese ore, and ferroalloys; other minerals imported included barite, ilmenite, rutile, salt, olivine, zircon, and fluorspar.

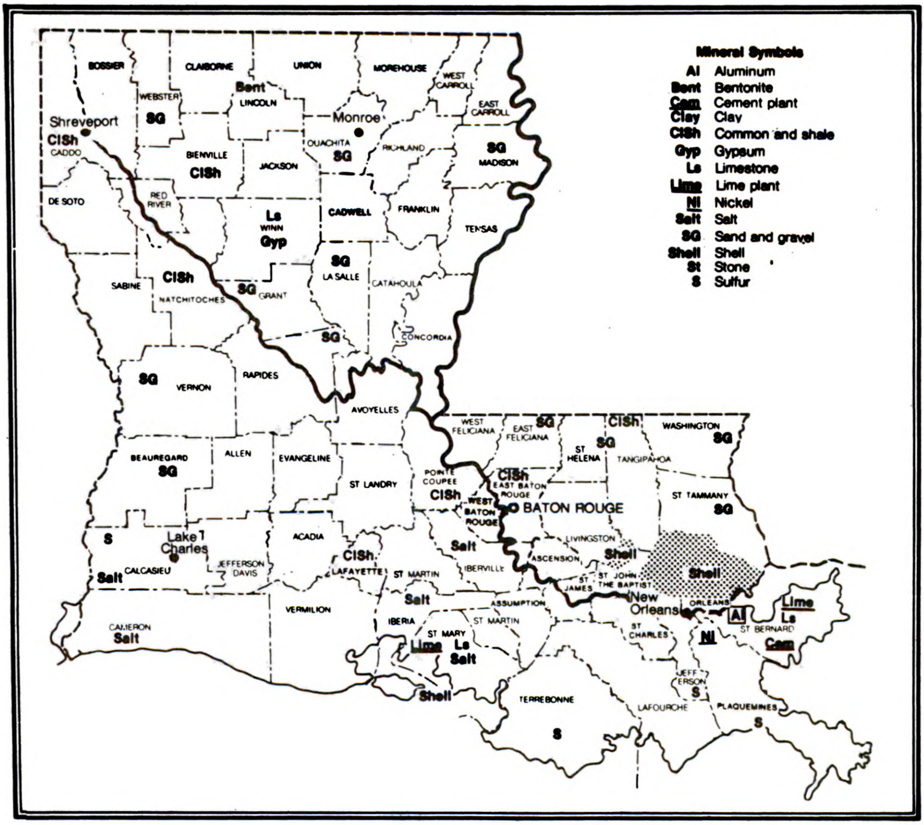

Figure 2.—Principal mineral producing localities in Louisiana.

The Dolet Hills Lignite Surface Mining Co. in De Soto Parish continued development of its mine mouth facility with its powerplant over two-thirds complete. The 6-million-ton-per-year operation was scheduled for startup in 1985. The facility is a joint venture of the Central Louisiana Electric Co. Inc. and South Western Electric Power Co. Toth Aluminum Corp., Vacherie, produced test quantities of metal chlorides during the year. The $8.5 million facility did not reach commercial production during 1984. Of the expected production, 65% will be silicon chloride, 34% aluminum chloride, and 1% titanium chloride. The operation, utilizing a kaolin chlorination process, reportedly used kaolin shipped in from Georgia.

The Louisiana Department of Commerce reported that expansions directly or indirectly affecting the mineral industries in 1984 totaled over $250 million; the majority of expansions was in the chemical industry. Products included in these expansions included agricultural chemicals, anhydrous ammonia, alumina and alumina chemicals, calcined coke and petroleum coke, carbon black, caustic chlorine, foundry castings, hydrofluoric acid, phosphoric acid, and sulfuric acid; 17 companies were involved in expansions. PPG Industries Inc. will be spending $35 million over the next 5 years to expand and modernize its high-purity silica plant at Lake Charles. The first phase was completed late in the year resulting in a 20% increase of capacity. Occidental Chemical Corp. invested $30 million to modernize its caustic soda and chlorine facility at Taft, with completion scheduled for 1986. Vulcan Materials Co. was investing $48 million at its plant in Geismar to construct a cogeneration unit with a capacity of 100 megawatts; completion was scheduled for 1985. Conoco Inc. invested $42 million at its coal calciner facility at Lake Charles. The facility, to be completed in 1986, will process 300,000 short tons of premium coke into calcined coke. End uses will be in electrodes for electric arc steel furnaces. Freeport Chemical Co. announced expansion programs totaling $4.2 million at its Uncle Sam phosphoric acid facility.

**Legislation and Government Programs.**—The Louisiana Capital Companies Tax Credit Program, passed by the State legislature in 1983, went into effect in July 1984. The legislation encourages the development of venture capital companies in the State. Corporate or individual investors in the new capital companies would receive a 35% tax credit against State tax liability when capitalizations are for $3 million or more. The capital companies must invest 60% of their initial capital in new and developing Louisiana businesses with no more than 10% of capital invested in any one business. The State reportedly took this action to reduce the heavy dependence on the oil and gas industry in Louisiana.

The State legislature passed legislation in 1984 to provide assistance to depressed energy-intensive industries. The legislation specifies the following criteria: The cost of electricity and natural gas used for power must exceed 33% of the total cost of the product; the industry agrees to dedicate 25% of the facility's profits to capital improvements; the industry must certify that its Louisiana plant has been substantially curtailed at least 12 months prior to June 1, 1984; and it must certify that the energy available would substantially aid in reopening of the facility. The legislation set up special electric rates for depressed energy-intensive industries and will allow the State to sell royalty natural gas at a negotiated rate tied to the market price of the product.

The Louisiana Geological Survey (LGS) conducted geological research to produce information useful in developing the State's natural resources and protecting the environment. Programs were formulated to provide data for use by regulatory offices within the department, industry, academic researchers, and the general public. LGS marked its 50th year of service in 1984, emphasizing coastal-related programs. These programs included the directional drilling and/or well relocation program, the coastal geology program, and the Outer Continental Shelf program. Other areas of involvement included a study of the State's near-surface coal resources in cooperation with the U.S. Geological Survey (USGS), a gas recovery program, a flood control program, and a study of the Amite River to determine the effects of gravel mining. LGS also established a new carbon-14 dating laboratory in cooperation with the Louisiana State University and published a new geologic map of Louisiana. The new map was the culmination of many years of geologic mapping.

The USGS conducted various basic geologic studies within the State of Louisiana, some in cooperation with the LGS. The USGS published Professional Paper 1300, "Wilderness Mineral Potential," which includes the Kisatchie Hills Wilderness in Louisiana. The report was prepared in cooperation with the U.S. Bureau of Mines.

Late in the year, the U.S. Bureau of Land Management (BLM) identified 64 parcels of land in Louisiana covering 5,892 acres of unleased Federal land presumed to contain oil and gas. BLM proposed that in 1985 it would publish a notice detailing the location of these unleased parcels to seek a response to determine priority of leasing.

The Mining and Mineral Resources and Research Institute at Louisiana State University in Baton Rouge, which was created under title III of Public Law 95-87, received a grant from the U.S. Bureau of Mines in fiscal year 1984 for operation and research. Since 1980, the Institute has received $966,710 from the Bureau.

The U.S. Bureau of Mines published several reports pertaining to salt mining in Louisiana. Two Reports of Investigations (RI), RI 8861, "Assessment of Methane Hazards in an Anomalous Zone of a Gulf Coast Salt Dome," and RI 8889, "Methane Content of a Gulf Coast Domal Rock Salt," were the result of research in Louisiana. In addition, Technology News Release No. 213, "Controlling Salt-Mine Cutting Machine Dust With a Low-Flow Foam Technique," was the result of research sponsored by the Bureau.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Barite.**—Imported and domestic barite was crushed and ground at 13 plants in Louisiana for use in oil and gas drilling; output increased over that of 1983. Of the imported barite shipped through the Port of New Orleans, the major portion was from China. Demand in the drilling mud market remained at a relatively low level.

**Calcium Chloride (Synthetic).**—Texas United Chemical Corp. produced calcium chloride using hydrochloric acid and limestone at its Lake Charles plant. Production and value increased over that of 1983; unit values decreased. Synthetic calcium chloride was used in road deicing, dust control, oil and gas drilling, concrete-set acceleration, and other uses.

**Cement.**—Lone Star Industries Inc. operated facilities in New Orleans, which included two wet-process kilns. Most of the output was portland cement with a small amount of masonry cement. Output of portland cement decreased, while masonry cement output increased. The decrease in demand occurred as construction activities remained relatively low and decreased further by yearend. Major end uses for portland cement were ready-mixed concrete, concrete products, building materials, and highway construction. Prices of portland cement increased more than $2 per short ton over those of 1983. Raw materials for the 750,000-ton-per-year plant were received at Lone Star's bulk material handling dock on the Michoud Canal near the plant. In 1984, about 600,000 tons of aragonite was imported from The Bahamas, down from nearly 1 million tons in 1983. Gypsum was imported from Jamaica while coal was received from domestic mines. Other raw materials used included clays, iron ore, limestone, and sand.

**Clays.**—Louisiana's clay industry produced common clay and bentonite in 1984; output of common clay increased while that of bentonite decreased. Common clay was mined by six companies at eight mines in six parishes. The major end use of common clay was primarily in manufacturing lightweight aggregates for use in concrete block and structural concrete. The decrease in construction activities adversely impacted common clay output. Average price of common clay decreased to $20.13 per short ton from $20.94 per ton in 1983. The Harshaw-Filtrol Partnership operated a bentonite mine in Claiborne Parish; the bentonite mined was a calcium montmorillonite. Material mined was shipped by rail to Jackson, MS, to produce acid-activated clays, which are used chiefly in clarifying mineral and vegetable oils. Because of problems associated with clay suitability, the mine was scheduled to close by yearend.

**Table 4.—Louisiana: Clays sold or used by producers**

(Thousand short tons and thousand dollars)

| Year | Quantity | Value |
|---|---|---|
| 1980 | 380 | 5,841 |
| 1981[1] | 380 | 6,338 |
| 1982 | 326 | [1]6,216 |
| 1983 | [1]505 | 10,793 |
| 1984 | 547 | [1]10,858 |

[1] Excludes bentonite.

**Fluorspar.**—Agrico Chemical Co., Donaldsville, and Freeport Chemical, Uncle Sam, operated fluosilicic acid facilities during 1984. Kaiser Aluminum & Chemical Corp. announced a $2.5 million expansion program at its Gramercy plant producing fluorocarbons. Allied Corp., Baton Rouge, announced a $5 million expansion program at its hydrofluoric acid facility.

**Gypsum.**—Anhydrite was mined by Winn Rock Inc. at its quarry near Winnfield, Winn Parish, with output decreasing from that of 1983. National Gypsum Co., Jefferson Parish, and United States Gypsum Co., Orleans Parish, produced calcined gypsum from crude material shipped into the State. Calcined gypsum output and value increased over that of 1983.

**Lime.**—Production of lime increased slightly as markets remained weak during the year; despite the increase, output remained at one of the lowest levels in over 10 years. Both hydrated lime and quicklime output were affected by weak market conditions with a resulting decrease in unit values. U.S. Gypsum produced both quicklime and hydrated lime from shells at its New Orleans facility. S. I. Lime Co. received quicklime from Kentucky and converted it to hydrated lime at its plant in Amelia. State production was used in water purification and softening, road stabilization, petrochemicals, and oil and grease.

**Nitrogen.**—Of the 46 domestic producers of anhydrous ammonia, 14 had operating facilities in Louisiana. Air Products & Chemicals Inc. started up its $40 million industrial gas plant at Convent. The plant will supply oxygen and nitrogen and also liquid oxygen, nitrogen, and argon. Announced expansions of anhydrous ammonia facilities were by Air Products & Chemicals, New Orleans ($14 million), and Triad Chemical Co., Donaldsonville ($10.8 million). Total annual capacity of anhydrous ammonia in Louisiana was over 6.5 million short tons or over 37% of national capacity.

**Perlite (Expanded).**—Filter Media Co. of Louisiana expanded perlite from crude material shipped into the State. Output decreased at its plant in Reserve, St. John the Baptist Parish, and was used as a filter aid, for insulation, and in concrete aggregate.

**Salt.**—Louisiana maintained its leading position nationally in production of salt with approximately one-third of the Nation's output. Production in 1984 increased but still was below the record high output of the late 1970's. Production and value increased 13.5% and 11.1%, respectively, over that of 1983, indicating a decrease in unit prices. Twelve companies recovered salt at 15 operations in 10 parishes. Of the operations, five were underground mines with the remaining being solution mines. The Louisiana Department of Revenue reported that nearly $400,000 was received in severance taxes from salt and brine operations.

Markets for salt appeared to be increasing as at least four companies in Louisiana producing caustic chemicals and chlorine announced expansion plans in 1984. Chlorine, caustic soda, and soda ash were the largest domestic markets, using over one-half of the Nation's output of salt. Kaiser, PPG Industries, Stauffer Chemical Co., and Occidental announced expansion plans totaling nearly $36 million.

Cargill Inc. permanently closed its Belle Isle salt mine early in the year. The 1.5-million-short-ton-per-year mine was in St. Mary Parish. The company concluded from studies of the salt dome structural integrity that mining should not continue; 155 employees were affected. Morton Salt Co. announced plans to increase capacity at its Weeks Island Mine by more than 300,000 tons per year. Morton will increase hoisting, handling, and loading capabilities and improve underground mining operations.

International Salt Co. continued its second phase of a $5.5 million efficiency improvement program at its Avery Island Mine. Included in the second phase were solid-state power rectifiers for hoisting, new drilling and scaling machines, extensions of hoisting to the mining level, and an increase of underground storage capabilities.

**Sand and Gravel.**—Louisiana produced both construction and industrial sand and gravel in 1984. Total sand and gravel output increased for the first time since 1976. The Louisiana Department of Revenue collected $930,000 in severance taxes from sand and gravel operations in 1984.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

**Table 5.—Louisiana: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 8,632 | $34,289 | $3.97 |
| Plaster and gunite sands | W | W | 2.51 |
| Concrete products | W | W | 2.16 |
| Asphaltic concrete | 390 | 1,756 | 4.50 |
| Road base and coverings[1] | 505 | 1,533 | 3.03 |
| Fill | 583 | 692 | 1.19 |
| Other | 6,930 | 16,395 | 2.37 |
| Total or average | 17,040 | [2]54,664 | 3.21 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes road and other stabilization (cement) and uses indicated by symbol W.

[2] Data do not add to total shown because of independent rounding.

Construction sand and gravel was the third leading commodity in value among the nonfuel minerals produced in Louisiana. Although output increased, it was still below the production levels during 1976-81. Construction activities remained stable early in the year, but decreased by yearend. Facilities at times operated intermittently, depending on proximity and extent of construction activities. Most operations were relatively small with no individual pit producing over 1.5 million short tons. The top

17 companies, with 37 operations, produced 80% of the construction sand and gravel. Production was at 95 operations by 65 companies and 1 State agency in 24 parishes. Leading parishes, in order of output, were St. Helena, St. Tammany, East Baton Rouge, and Webster. The major portion of the construction sand and gravel was shipped by truck, with lesser amounts by rail and water.

*Industrial.*—Three companies produced industrial sand and gravel in four parishes in 1984, with output decreasing slightly. Primary markets in the glass and foundry industries remained depressed. Operations were relatively small with individual output below 150,000 tons per year.

**Stone (Crushed).**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Output of crushed stone in Louisiana was estimated to have decreased from that of 1983; material mined included anhydrite and shell. The State Department of Revenue reported that severance taxes of over $260,000 for shell and $18,000 for anhydrite were collected in 1984. Shell continued to account for over 90% of the State's total output of crushed stone and more than one-half of the national output of shell. Three companies produced shell in Orleans and St. Mary Parishes, while one company mined anhydrite at one quarry in Winn Parish. Crushed stone was used primarily for coarse and fine aggregate, cement manufacture, and lime manufacture. Anhydrite was used basically as a road base with demand remaining at a relatively low level. Winn Rock, operator of the anhydrite quarry, after conducting feasibility studies concerning a possible limestone quarry in Winn Parish, delayed a decision pending improved market conditions.

Oyster shell dredging remained under attack for environmental reasons, prompting the Governor to impose a 2-year moratorium on any new dredging permits pending a 2-year study to determine the effects of dredging on the environment. Late in the year, shell dredging was banned in Lake Maurespas because sediment was blocking plant growth. In addition, protective zones around oil and gas wells and pipeline rights-of-way were established in Lake Pontchartrain, thereby banning dredging in these areas. Several bills were introduced in the State legislature to prohibit dredging but did not pass. Several suits were filed to stop dredging, citing lack of an environmental impact statement and failure to follow State bid laws. The State Department of Natural Resources (DNR) proposed that the number of days for dredging be 265, down from the present average of about 310 days. The three dredging companies filed suit against the State late in the year because of the banning of dredging in Lake Maurespas. The companies claim the State illegally modified its shell dredging permits through failure to give adequate notice and the opportunity to be heard. Late in the year, DNR conducted hearings to review permits for dredging along the State's coast and in the lakes.

**Sulfur.**—Louisiana ranked second in the Nation in output of Frasch sulfur, and sixth in recovered elemental sulfur. Sulfur remained the leading nonfuel mineral in terms of value in Louisiana. Frasch sulfur shipments and value increased over those of 1983; although output increased, production was still below that of the 1970's. The State Department of Revenue reported severance taxes of over $2 million were collected on sulfur production in 1984. Freeport Minerals Co. had Frasch facilities at Garden Island Bay, Grand Isle, and Caillou Island. Freeport Minerals ceased drilling operations at Caillou Island early in the year with production ending at yearend. The facility, developed in 1980, closed because of declining production and increased costs.

Output of recovered sulfur also increased along with unit values; output was at its highest level in over 10 years. Byproduct sulfur was recovered by nine companies in seven parishes.

Expansions in industries utilizing sulfur were announced during the year. Both Olin Corp., in Shreveport, and Stauffer Chemical, in Baton Rouge, announced expansion plans at their sulfuric acid facilities at a combined cost of $3.5 million.

**Table 6.—Louisiana: Sulfur produced and shipped from Frasch mines**

(Thousand metric tons and thousand dollars)

| Year | Production | Shipments | |
|---|---|---|---|
| | | Quantity | Value |
| 1980 | 2,309 | 2,590 | W |
| 1981 | 2,440 | 2,235 | W |
| 1982 | 1,312 | 1,239 | W |
| 1983 | 1,286 | 1,643 | W |
| 1984 | 1,937 | 2,007 | W |

W Withheld to avoid disclosing company proprietary data.

**Vermiculite (Exfoliated).**—W. R. Grace & Co. exfoliated vermiculite at its plant in New Orleans with output remaining at about the same level as that of 1983. Principal end uses were in concrete and plaster aggregates, horticulture, loose fill insulation, and block insulation.

## METALS

**Aluminum.**—Louisiana remained 1 of 17 States capable of producing aluminum, although no production was reported in 1984. Reduced demand nationwide, along with lower prices and high energy costs, caused a severe cutback throughout the industry. The Louisiana Department of Commerce reported expansion expenditures by Kaiser of over $50 million for modifications at its facilities at Baton Rouge, Chalmette, and Gramercy, the major portion being at the Gramercy alumina facilities. Kaiser closed its aluminum production facilities at Chalmette, citing high operating costs; the facility had not produced aluminum since 1983. Employment in Chalmette in 1981 was 2,700 workers, but by midyear 1984 had been reduced to about 85; only the coke calciner remained in operation. Negotiations to reopen the 260,000-short-ton-per-year plant continued during the year with no success. The State legislature passed a bill, aimed at assisting Kaiser, by providing assistance to all depressed energy-intensive industries. Energy costs for Kaiser were estimated at about 40 mills per kilowatt hour compared with a worldwide cost below 20 mills per kilowatt hour. Kaiser started up its new high-purity, catalyst-grade alumina plant at Baton Rouge late in the year; Kaiser's Gramercy alumina plant remained in operation during the year.

Reynolds Metals Co. announced a $5 million expansion and modernization of its Lake Charles carbon anode plant. The recently reopened plant produced calcined petroleum coke and carbon anodes used in production of primary aluminum. Ormet operated its plant at Burnside at reduced capacity during the year, shipping alumina to its smelter in Hannibal, OH. The port at Burnside reported 900,000 tons of bauxite and over 500,000 tons of alumina were handled at its facilities; 700,000 tons of the bauxite was destined for Ormet. Ormet announced expenditures of about $5 million for expansion and modernization during 1984.

**Iron and Steel.**—Bayou Steel Corp. operated its minimill at LaPlace at near capacity during the year with a scheduled maintenance shutdown for 2 weeks. Earlier in the year, Bayou rescinded a planned price increase for its bar and beam products when other minimills failed to follow the move. Bayou reported a price squeeze because of high scrap price levels. The facility at LaPlace, in addition to producing light bars and sections, produced forging billets and heavy bars.

Iron and steel foundries constituted only a small part of the mineral industry in Louisiana. Raw materials consumed included scrap, coal, limestone, and sand, nearly all of which came from sources in the Southeast. According to the "Directory of Louisiana Manufacturers," 12 gray iron foundries, 6 steel foundries, and 1 malleable iron foundry were in operation in the State. The operations were relatively small with only 8 employing more than 100 people. Avondale Shipyards Inc. announced a $6 million expansion and modernization program at its steel casting foundry at Waggaman.

**Nickel.**—AMAX Inc.'s Port Nickel nickel refinery in Braithwaite was shut down for over 1 month during the year. The plant had a reported capacity of 80 million pounds of nickel, 47 million pounds of copper, and 100,000 short tons of ammonium sulfate. Although cobalt refinery capacity is 2 million pounds, during the year, cobalt hydroxide was shipped to Canada for refining into powder electrodes. The plant processed a nickel-copper matte imported from Botswana and Australia. Imports of nickel matte through the Lower Mississippi River increased from 54,515 tons in 1983 to 80,738 tons in 1984. AMAX's operation reportedly refined about 68 million pounds of nickel powder and briquet, 800,000 pounds of cobalt (including intermediates), and 25,500 tons of copper in 1984.[4]

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] State geologist, Louisiana Geological Survey, Baton Rouge, LA.

[3] Federal Reserve Bank of Atlanta. Economic Review. Feb. 1985, pp. 45-47.

[4] Metals Week. V. 56, Nc. 12, Mar. 25, 1985, p. 8.

## Table 7.—Principal producers

| Commodity and company | Address | Type of activity | Parish |
|---|---|---|---|
| Aluminum: | | | |
| Kaiser Aluminum & Chemical Corp | Box 1600<br>Chalmette, LA 70043 | Plant | St. Bernard. |
| Cement: | | | |
| Lone Star Industries Inc | 1 Greenwich Plaza<br>Box 5050<br>Greenwich, CT 06830 | do | Orleans. |
| Clays: | | | |
| Big River Industries Inc | Box 66377<br>Baton Rouge, LA 70806 | Mine and plant | Pointe Coupee. |
| Kentwood Brick & Tile Manufacturing Co. Inc. | Drawer F<br>Kentwood, LA 70444 | do | St. Helena. |
| Gypsum: | | | |
| National Gypsum Co | Box 128<br>Westwego, LA 70094 | Plant | Jefferson. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Orleans. |
| Winn Rock Inc | Box 790<br>Winnfield, LA 71483 | Quarry | Winn. |
| Lime: | | | |
| S. I. Lime Co., Pelican State Lime Div | 3 Riverchase Office Plaza<br>Suite 204<br>Birmingham, AL 35244 | Plant | St. Mary. |
| USG Industries Inc | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Orleans. |
| Salt: | | | |
| Cargill Inc | Cargill Bldg.<br>Minneapolis, MN 55402 | Underground mine | St. Mary. |
| Domtar Chemicals Inc., Shifto Salt Div | 4825 North Scott<br>Shiller Park, IL 60176 | do | Do. |
| The Dow Chemical Co | Midland, MI 48640 | Brine wells | Iberville. |
| International Salt Co | Clarks Summit, PA 18411 | Underground mine | Iberia. |
| Morton Salt Co | 110 North Wacker Dr.<br>Chicago, IL 60606 | do | Do. |
| PPG Industries Inc | Box 1000<br>Lake Charles, LA 70604 | Brine wells | Calcasieu. |
| Sand and gravel: | | | |
| Gifford-Hill & Co. Inc | Box 6615<br>Shreveport, LA 71136 | Dredges, pits, plants. | Jefferson Davis, Rapides, Webster. |
| Louisiana Sand and Gravel Co | Box 963<br>Baton Rouge, LA 70821 | Dredges and plants | St. Helena. |
| Rebel Sand & Gravel Co | Box 245<br>Denham Spring, LA 70726 | do | Do. |
| Texas Industries Inc | Box 5472<br>Alexandria, LA 71301 | Dredges, pits, plants. | Ouachita, Rapides, St. Tammany, Vernon, Washington. |
| Stone: | | | |
| Crushed: | | | |
| Winn Rock Inc | Box 790<br>Winnfield, LA 71483 | Quarry and plant | Winn. |
| Shell: | | | |
| Louisiana Materials Co | Box 8214<br>New Orleans, LA 70182 | Dredge | Orleans. |
| Pontchartrain Dredging Corp | Box 8005<br>New Orleans, LA 70182 | do | Do. |
| Radcliff Materials Inc | Box 151<br>Morgan City, LA 70381 | Dredges | Orleans and St. Mary. |
| Sulfur: | | | |
| Native: | | | |
| Freeport Minerals Co | 200 Park Ave.<br>New York, NY 10166 | Frasch process | Jefferson, Plaquemines, Terrebonne. |
| Recovered: | | | |
| Cities Service Oil Co | Box 300<br>Tulsa, OK 74102 | Refinery | Calcasieu. |
| Exxon Co. U.S.A. | Box 551<br>Baton Rouge, LA 70821 | Plant | East Baton Rouge. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 62 Whittemore Ave.<br>Cambridge, MA 02140 | do | Orleans. |

# The Mineral Industry of Maine

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Maine Geological Survey for collecting information on all nonfuel minerals.**

**By L. J. Prosser,[1] Walter Anderson,[2] and Carolyn Lepage[3]**

The value of nonfuel mineral production in Maine in 1984 was $37.9 million, a 44% increase over that of 1983. The increase reflected improved demand from the construction industry, which consumes most of the State's production. The possibility for development of a metal mine in Maine diminished as exploration activity waned in the second half of the year.

**Table 1.—Nonfuel mineral production in Maine[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | 43 | $93 | 43 | $97 |
| Sand and gravel (construction) do. | $^e$4,800 | $^e$12,100 | 7,885 | 19,228 |
| Stone (crushed) do. | 848 | 2,851 | $^e$1,300 | $^e$4,400 |
| Combined value of other nonmetals | XX | 11,319 | XX | 14,214 |
| Total | XX | 26,363 | XX | 37,939 |

$^e$Estimated. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Maine, by county

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Androscoggin | W | $30 | Clays. |
| Aroostook | $948 | W | Stone (crushed). |
| Cumberland | W | W | Stone (crushed), clays. |
| Franklin | W | W | Garnet. |
| Hancock | 524 | W | Stone (dimension). |
| Kennebec | 564 | W | Do. |
| Knox | W | W | Cement, stone (crushed). |
| Lincoln | 598 | (1) | |
| Oxford | 284 | (1) | |
| Penobscot | 2,011 | (1) | |
| Piscataquis | 284 | (1) | |
| Sagadahoc | W | (1) | |
| Somerset | 1,297 | (1) | |
| Waldo | W | W | Peat. |
| Washington | 716 | 814 | Peat, stone (dimension). |
| York | 2,819 | (1) | |
| Undistributed[2] | 21,660 | 13,419 | |
| Sand and gravel (construction) | XX | $^{e}$12,100 | |
| Stone (crushed) | $^{e}$4,000 | XX | |
| Total | $^{r}$35,705 | 26,363 | |

$^{e}$Estimated. $^{r}$Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[2] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

## Table 3.—Indicators of Maine business activity

| | | 1982$^{r}$ | 1983 | 1984$^{p}$ |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 1,136 | 1,145 | 1,156 |
| Total civilian labor force | do | 516 | 537 | 552 |
| Unemployment | do | 44 | 48 | 34 |
| Employment (nonagricultural): | | | | |
| Mining total | do | .1 | .2 | .2 |
| Manufacturing total | do | 108.6 | 109.2 | 110.4 |
| Primary metal industries[1] | do | 24.8 | 20.9 | NA |
| Stone, clay, and glass products[1] | do | 7.8 | 6.6 | NA |
| Chemicals and allied products[1] | do | 13.1 | 12.5 | NA |
| Petroleum and coal products[1] | do | .8 | .8 | NA |
| Construction | do | 16.7 | 16.9 | 19.4 |
| Transportation and public utilities | do | 18.5 | 18.4 | 19.3 |
| Wholesale and retail trade | do | 90.5 | 94.5 | 102.1 |
| Finance, insurance, real estate | do | 17.5 | 18.1 | 19.6 |
| Services | do | 81.5 | 84.6 | 90.5 |
| Government and government enterprises | do | 82.1 | 83.1 | 84.0 |
| Total | do | 415.5 | 425.0 | 445.5 |
| Personal income: | | | | |
| Total | millions | $10,532 | $11,335 | $12,505 |
| Per capita | | $9,268 | $9,900 | $10,813 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 40.0 | 39.9 | 39.9 |
| Total average hourly earnings, production workers | | $7.22 | $7.61 | $8.05 |
| Earnings by industry: | | | | |
| Farm income | millions | $77 | $56 | $108 |
| Nonfarm | do | $7,115 | $7,751 | $8,566 |
| Mining total | do | $3 | $3 | $3 |
| Manufacturing total | do | $2,094 | $2,252 | $2,449 |
| Primary metal industries | do | $8 | $10 | $14 |
| Stone, clay, and glass products | do | $20 | $20 | $22 |
| Chemicals and allied products | do | $16 | $19 | $20 |
| Petroleum and coal products | do | $5 | $7 | $8 |
| Construction | do | $369 | $399 | $499 |
| Transportation and public utilities | do | $441 | $483 | $524 |
| Wholesale and retail trade | do | $1,129 | $1,244 | $1,386 |
| Finance, insurance, real estate | do | $305 | $351 | $402 |
| Services | do | $1,310 | $1,433 | $1,605 |
| Government and government enterprises | do | $1,413 | $1,510 | $1,618 |

See footnotes at end of table.

**Table 3.—Indicators of Maine business activity —Continued**

| | 1982r | 1983 | 1984p |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 3,171 | 4,174 | 5,902 |
| Value of nonresidential construction millions | $147.2 | $184.6 | $161.5 |
| Value of State road contract awards do | $38.1 | $45.8 | $22.0 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 206 | 231 | 275 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $35.7 | $26.4 | $37.9 |
| Value per capita | $31 | $23 | $33 |

pPreliminary. rRevised. NA Not available.
[1]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

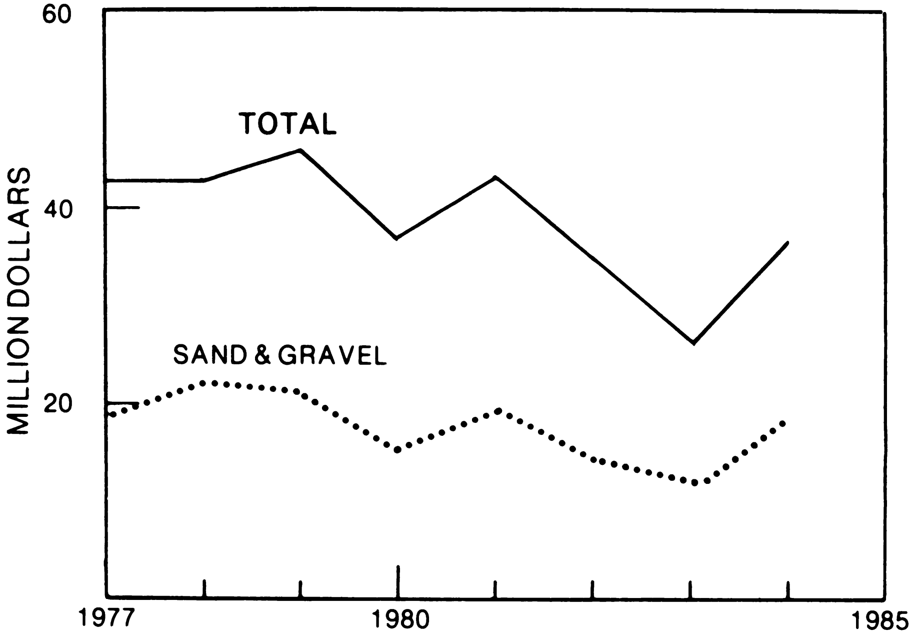

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Maine.

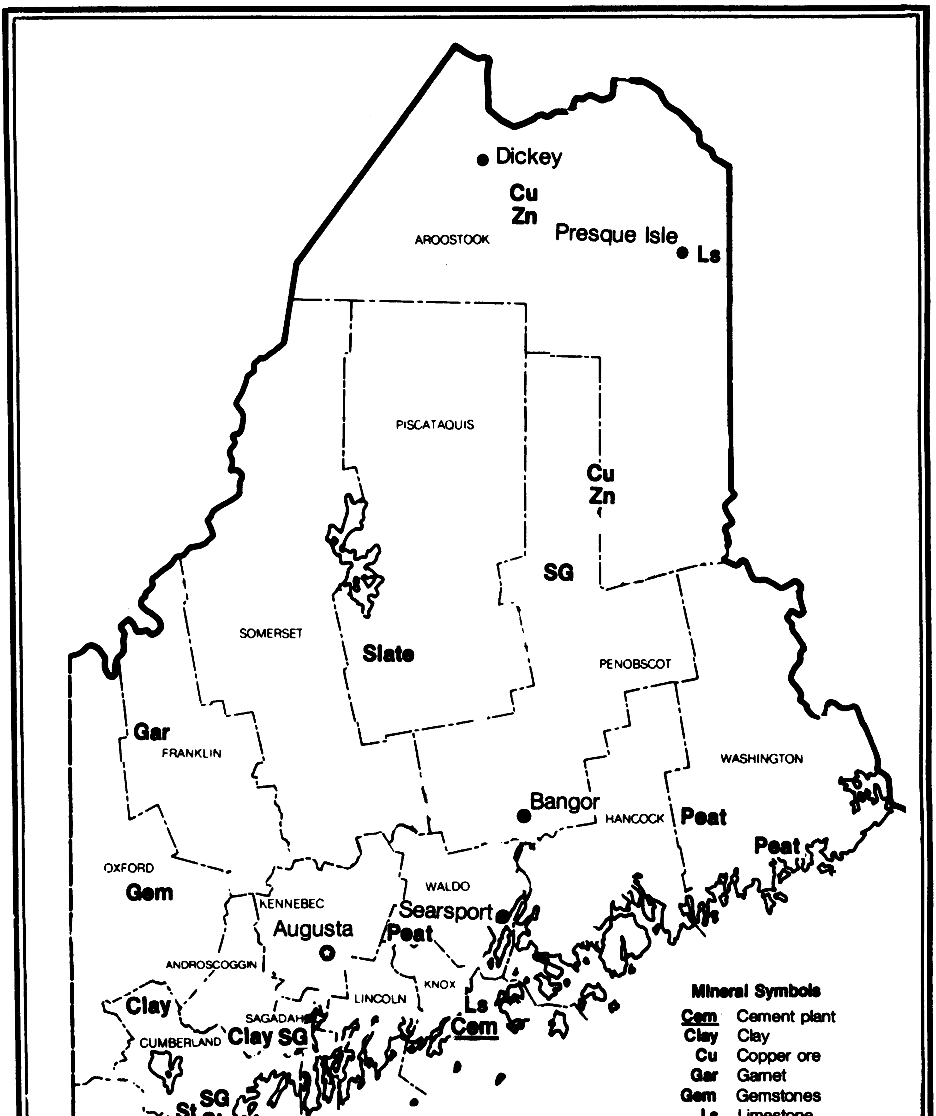

Figure 2.—Principal mineral producing localities in Maine.

**Trends and Developments.**—Maine's mineral industry, as was typical of the New England region, increased production in response to demand for construction mineral commodities. Construction activity in Maine (see table 3) improved significantly in 1984 compared with that of 1983; correspondingly, cement, crushed stone, and construction sand and gravel output increased 41%, 53%, and 64%, respectively.

**Exploration Activities.**—At yearend 1983, Freeport Exploration Co., a division of Freeport McMoRan Inc., and Getty Mining Co., a subsidiary of Getty Oil Co., both announced plans to intensify exploration in 1984. Freeport used reverse circulation drilling to determine if higher grades of precious metals existed at the 36-million-ton copper-zinc deposit discovered at Bald Mountain in northern Maine by Superior Mining Co. and Louisiana Land & Exploration Co. in 1977. Upon completion of drilling about 70 new holes and a feasibility study, the precious metal zone of the deposit was not considered as promising as expected and activity was halted. The property leased by Freeport reverted to Superior Mining and Louisiana Land & Exploration.

Getty Mining discovered a multimetallic ore deposit including precious metals north of Patten at Mount Chase. In July, Texaco Inc. acquired Getty, and work on the Mount Chase project by yearend was minimized with only water quality monitoring continuing. Texaco announced plans to divest itself of Getty subsidiaries, and projects such as Mount Chase were expected to be sold on an individual basis.

The Mineral Resource Div. of Boise Cascade Corp. began a 5-year reconnaissance program to assess the mineral potential of its corporate lands in Maine. The Penobscot Indian Nation's Mining and Minerals program completed the first year of a total mineral resource evaluation of Penobscot and Passamaquoddy Indian Trust Lands. The tribal Trust Lands comprise about 120,000 acres scattered across the central part of the State.

A number of other companies continued exploring for base and precious metals in Maine. Chevron Resources Co. took over as operator of Superior Mining and Louisiana Land & Exploration lands outside of the Bald Mountain joint venture. Chevron also has leases on other Aroostook County lands.

Utah International Inc. concentrated its search for base and precious metals in the Jim Pond area in northern Franklin County. Noranda Exploration Inc. conducted programs in central Somerset and northern Franklin Counties.

F. M. Beck Inc. was actively involved in contract exploration work for several clients in the State. This work included the Mount Chase deposit and other Getty properties in Maine. Appalachian Resources Inc. and J. S. Cummings Inc. were also active in the State.

Scintilore Exploration Ltd. conducted limited exploration for silver at its Big Hill property in Pembroke, eastern Washington County, and concentrated on arranging financing.

**Legislation and Government Programs.**—In 1984, the Maine Legislature enacted Public Law, chapter 819, giving the Land Use Regulation Commission sole regulatory responsibility for sand and gravel pits, stream alterations, and projects affecting lakes and ponds in the State's 10.3 million acres of unorganized townships and plantations. Previously, these activities were regulated by three separate agencies under the Site Location Law, the Great Ponds Act, and the Alteration of Rivers and Streams Act.

Highlights of Maine Geological Survey's (MGS) activities in 1984 included publication of a five-volume atlas on Maine's peat resources. Information for the atlas was collected through a 5-year research project funded by the U.S. Department of Energy. This comprehensive assessment of Maine's peat resources provided maps and data on 235 peat deposits, covered 73,000 acres, and identified 136 million air-dried tons of commercial-quality peat. Peat deposits suitable for energy were the primary focus of the study, but the information gathered was also useful to those interested in peat for agricultural, horticultural, and other applications.

The MGS entered a cooperative agreement with the U.S. Geological Survey to update and add information to the nationwide Mineral Resources Data System. In 1984, work began on recording information on location, exploration, development, and geology for each metallic deposit.

During 1984, the MGS released 11 open-file maps primarily relating to the hydrology and geology of Maine and completed new black and white 1:500,000 State bedrock and surficial geologic maps. Both were expected to be printed in color in 1985.

The MGS began a 5-year project with the Minerals Management Service to determine the stratigraphic framework of the State's nearshore area and evaluate the potential economic deposits. Work began in 1984 on a map of the seafloor of the inner Continental Shelf.

Additional information on publications and MGS projects may be obtained from the Maine Geological Survey, State House Station No. 22, Augusta, ME 04333, telephone 207-289-2801.

# REVIEW BY NONFUEL MINERAL COMMODITIES

## NONMETALS

**Cement.**—Shipments increased 41% in 1984 compared with that of 1983, reflecting improved demand from the construction industry. Portland and masonry cement were produced at the Dragon Cement Co. plant in Thomaston. The wet process, coal-fired plant is the only cement manufacturing facility in New England.

**Clays.**—Late in the year, Royal River Brick Co. Inc. decided to cease clay mining and brick manufacturing operations in Gray, Cumberland County. The company manufactured water-struck brick used primarily in restoration projects. With the closing of Royal River and the termination of clay mining by Dragon Cement in 1983, only one clay mining company remained in operation in Maine. The company mined common clay at two pits, one in Androscoggin County, the other in Cumberland County.

**Garnet.**—Maine again ranked second nationally in garnet production. Industrial Garnet Extractives Inc. (IGE), West Paris, was one of four garnet producers in the United States. IGE, two companies in New York, and one in Idaho accounted for the total domestic output of 27,672 short tons (State and individual company data are proprietary). U.S. output declined slightly compared with that of 1983, whereas IGE's output increased 6%.

IGE continued modernizing its plant adding new screening, concentrating, and dust collecting equipment and converting from wet to dry processing. The new processing system, in addition to increasing capacity, enabled year-round operation of the plant by eliminating water from the processing cycle. Previously, the plant was often forced to close in winter. The upgrading of the facility was considered an indication of the increasing market demand for garnet for sandblasting and water filtration applications. Health concerns relating to use of silica sand and slag have also boosted the use of garnet in sandblasting, primarily because of garnet's inert composition. IGE also sold a utility grit, a byproduct material of the processing that contained 10% to 15% garnet.

**Gem Stones.**—Maine ranked fifth nationally in the estimated value of gem stone and mineral specimens sold commercially. Plumbago Mining Corp., which mined tourmaline from a pegamatite on Newry Mountain in 1972 and 1973, planned to renew mining operations at Mount Apatite in 1985.

**Peat.**—Down East Peat Co. announced plans to construct a $20 million peat-fired electrical generating plant in Deblois, Washington County. Previously, Down East, the State's leading peat producer in 1984, mined sphagnum moss at the 1,000-acre Denbo Heath peat bog primarily for horticultural applications. The new power station, with a 12-megawatt capacity, was expected to be operational in 1986 and provide the power equivalent to that needed for a residential community of 20,000 people. Instrumental in Down East's development plans for the plant was securing a 20-year sales contract with Boston Edison Co. of Massachusetts for about 80% of the electricity. That contract also helped Down East to obtain additional financing for the project. The company also plans to convert about 20% of the peat into pellets for local sales at an estimated price of $70 per short ton.

Nationally in 1984, about 11,000 of the 814,000 tons of peat mined were used as a fuel to generate electricity. The Maine project was expected to add significantly to that total. Maine's peat resources, which included 235 peat deposits covering 73,000 acres of commercial-quality peat portend the possibility of additional development of peat-fired powerplants (see Legislation and Government Programs).

Plans by Signal Cleanfuels Inc. and United States Peat Co. to begin operations failed to materialize. Signal expected to begin construction on a $90 million peat-to-energy plant after receiving preliminary approval in June 1983 for the project from the federally funded Synthetic Fuels Corp. The project again remained on hold in 1984 pending a decision by the U.S. Congress on funding for Synthetic Fuels Corp. U.S. Peat failed to complete environmentally related applications required by the Maine Department of Environmental Protection. The company's plans for this project were unknown at yearend.

**Perlite (Expanded).**—Grefco Inc.'s acquisition of Chemrock Corp. included Chemrock's plant at Rockland. Grefco, a subsidiary of General Refractories Co., operated two perlite mines in New Mexico. At the Rockland plant, perlite was expanded and sold locally as a filter aid.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of 7.9 million short tons of construction sand and gravel in 1984 was the highest reported since 1979 when about 11 million tons were produced. In 1979, the unit price of sand and gravel was $1.85 (f.o.b. plant); in 1984, it was $2.44. Nationally, the unit price was $2.27 in 1979 and $2.90 in 1984.

**Table 4.—Maine: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 552 | $2,112 | $3.83 |
| Plaster and gunite sands | W | W | 3.46 |
| Concrete products | W | W | 3.00 |
| Asphaltic concrete | 607 | 2,350 | 3.87 |
| Road base and coverings | 2,580 | 4,446 | 1.72 |
| Fill | 637 | 1,422 | 2.23 |
| Snow and ice control | 357 | 836 | 2.34 |
| Railroad ballast | W | W | 4.17 |
| Other | 3,152 | 8,060 | 2.56 |
| Total or average | 7,885 | [1]19,228 | 2.44 |

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1] Data do not add to total shown because of independent rounding.

**Table 5.—Maine: Construction sand and gravel sold or used by producers, by county**

(Thousand short tons and thousand dollars)

| County | 1979 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Androscoggin | 1,019 | 2,050 | 575 | 2,095 |
| Aroostook | 1,109 | 1,855 | 1,028 | 2,487 |
| Cumberland | 1,936 | 3,476 | 1,193 | 3,168 |
| Franklin | 345 | 851 | 165 | 526 |
| Hancock | 552 | 1,182 | 578 | 1,266 |
| Kennebec | 593 | 908 | 417 | 622 |
| Knox | 395 | 966 | 353 | 1,372 |
| Lincoln | 300 | 478 | 319 | 625 |
| Oxford | 170 | 288 | 236 | 589 |
| Penobscot | 1,694 | 3,106 | 782 | 1,668 |
| Piscataquis | 246 | 489 | 145 | 243 |
| Sagadahoc | 83 | 124 | 304 | 395 |
| Somerset | 458 | 782 | 345 | 1,194 |
| Waldo | 588 | 1,077 | 259 | 701 |
| Washington | 335 | 506 | 250 | 343 |
| York | 1,200 | 2,396 | 935 | 1,935 |
| Total[1] | 11,022 | 20,534 | 7,885 | 19,228 |

[1] Data may not add to totals shown because of independent rounding.

The eight leading producers (see table 6) in 1984 accounted for 50% of the State's production and operated 43% of Maine's 218 active pits. The Maine Department of Transportation, with operations in 13 of the State's 16 counties, produced 15% of the State's total output from 70 pits.

**Stone.**—Stone production is surveyed by the Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Output of crushed stone increased 53% in 1984, recovering in line with the improved demand from the State's construction and cement industries. Limestone, sandstone, marl, and traprock were the types of stone mined.

*Dimension.*—The State's dimension stone industry, inactive since the 1970's, resumed production in 1983 at two granite quarries, one on Deer Island, the other at Jonesport. Reopening of two more dormant quarries on Vinalhaven Island in 1985 was pending a marketability study on demand for granite facing blocks.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] State Geologist and Director, Maine Geological Survey, Augusta, ME.

[3] Geologist, Maine Geological Survey, Augusta, ME.

## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Dragon Cement Co.[1] | Thomaston, ME 04861 | Quarry and plant | Knox. |
| Clays: | | | |
| Morin Brick Co | Mosher Rd.<br>Gorham, ME 04038 | Pits and mills | Androscoggin and Cumberland. |
| Garnet: | | | |
| Industrial Garnet Extractives Inc | Box 56A<br>West Paris, ME 04289 | Mill | Oxford. |
| | | Quarry | Franklin. |
| Peat: | | | |
| Down East Peat Co | Star Route<br>Deblois, ME 04622 | Bog and plant | Washington. |
| Pioneer Peat Moss Co | Columbia Falls, ME 04623 | do | Do. |
| Perlite (expanded): | | | |
| Grefco Inc | Box 177<br>Thomaston, ME 04861 | Plant | Knox. |
| Sand and gravel (construction): | | | |
| Cianbro Corp | Box D<br>Pittsfield, ME 04967 | Pits and plants | Androscoggin, Franklin, Hancock, Somerset. |
| Harry C. Crooker & Sons Inc | R.F.D. 4, Old Bath Rd.<br>Brunswick, ME 04011 | do | Lincoln and Sagadahoc. |
| R. J. Grondin & Son | Rural Route 4, Box 65<br>Gorham, ME 04038 | Pits | Cumberland and York. |
| Lane Construction Corp.[1] | Box 627<br>Presque Isle, ME 04769 | do | Aroostook, Penobscot, Waldo, Washington. |
| Madawaska Brick & Block Co | R.D. 1, Box 250<br>Madawaska, ME 04765 | Pit and plant | Aroostook. |
| Maine Department of Transportation. | Augusta, ME 04333 | Pits and plants | Androscoggin, Aroostook, Franklin, Hancock, Kennebec, Knox, Lincoln, Oxford, Penobscot, Piscataquis, Sagadahoc, Waldo, Washington. |
| Portland Sand & Gravel Co. Inc | Gray Rd.<br>Cumberland, ME 04021 | Pit and plant | Cumberland. |
| Tilcon Inc | Box 209<br>Fairfield, ME 04937 | Pits and plants | Cumberland, Somerset, York. |
| Stone: | | | |
| Crushed: | | | |
| Blue Rock Industries | 58 Main St.<br>Westbrook, ME 04092 | Quarries and mill | Cumberland and Kennebec. |
| The Cook Concrete Co | 150 Causeway St.<br>Boston, MA 02114 | Quarry and mill | Cumberland. |
| Lime Products Corp | Box 357<br>Union, ME 04862 | Quarries and mill | Knox. |
| Dimension: | | | |
| Maine-New Hampshire Granite Corp. | Box 207<br>Milford, NH 03055 | Quarry | Washington. |
| New England Stone Industries Inc. | Providence Pike<br>Smithfield, RI 02917 | do | Hancock. |

[1] Also stone.

# The Mineral Industry of Maryland

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Maryland Geological Survey for collecting information on all nonfuel minerals.**

### By William A. Bonin[1]

In 1984, Maryland's nonfuel mineral production, which also included very large shipments of cement, was valued at $241.7 million. This $42.3 million increase was 21% over that of 1983, the former record high. The leading commodities in terms of value were cement, crushed stone, construction sand and gravel, common clay and shale, dimension stone, industrial sand, ball clay, and peat.

Water-granulated blast furnace slag was processed for slag cement, and air-cooled iron slag and steel slag was used for construction aggregate and as road base and fill material. Gypsum and vermiculite shipments were received for further processing, and some quicklime and hydrated lime was manufactured for industrial and agricultural use.

Alumina and iron ore concentrate were shipped into the State for the production of metals. Titanium dioxide pigments were also manufactured.

**Table 1.—Nonfuel mineral production in Maryland[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays[2] thousand short tons | 484 | $1,747 | 347 | $1,484 |
| Gem stones | NA | 2 | NA | 2 |
| Lime thousand short tons | 7 | 383 | 7 | 419 |
| Peat do. | 4 | W | 5 | W |
| Sand and gravel (construction) do. | $^{e}$10,600 | $^{e}$37,800 | 14,234 | 46,671 |
| Stone: | | | | |
| Crushed do. | 19,284 | 80,429 | $^{e}$22,100 | $^{e}$94,000 |
| Dimension do. | 12 | 682 | $^{e}$17 | $^{e}$864 |
| Combined value of cement, clays (ball clay), sand and gravel (industrial, 1984), and values indicated by symbol W | XX | 78.366 | XX | 98,261 |
| Total | XX | 199,409 | XX | 241,701 |

$^{e}$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball clay; included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Maryland, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Allegany | (2) | W | Stone (crushed). |
| Anne Arundel | $7,485 | (3) | |
| Baltimore[4] | W | W | Stone (crushed), clays, stone (dimension). |
| Carroll | W | W | Cement, stone (crushed), clays. |
| Cecil | W | W | Stone (crushed). |
| Charles | 4,816 | (3) | |
| Dorchester | W | (3) | |
| Frederick | W | W | Cement, stone (crushed), clays, lime. |
| Garrett | W | $1,163 | Stone (crushed), peat, stone (dimension). |
| Harford | 509 | W | Stone (crushed). |
| Howard | (2) | W | Stone (dimension). |
| Kent | 23 | -- | |
| Montgomery | (2) | W | |
| Prince Georges | 7,559 | 201 | Clays. |
| Queen Annes | (2) | W | Stone (crushed). |
| St. Marys | 376 | (3) | |
| Washington | W | W | Cement, stone (crushed), clays. |
| Wicomico | W | (3) | |
| Worcester | 1,168 | (3) | |
| Undistributed[5] | 75,081 | 160,245 | |
| Sand and gravel (construction) | XX | [e]37,800 | |
| Stone: | | | |
| Crushed | [e]73,500 | XX | |
| Dimension | [r] [e]470 | XX | |
| Total | [r] [6]170,991 | 199,409 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes Baltimore City.

[5] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[6] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Maryland business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 4,270 | 4,299 | 4,349 |
| Total civilian labor force | do | 2,164 | 2,203 | 2,244 |
| Unemployment | do | 183 | 152 | 121 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 2.0 | 1.9 | 1.6 |
| Nonmetallic minerals except fuels[2] | do | .8 | .7 | NA |
| Coal mining[2] | do | 1.2 | 1.0 | NA |
| Manufacturing total | do | 215.3 | 214.1 | 218.1 |
| Primary metal industries | do | 24.8 | 21.0 | 18.9 |
| Stone, clay, and glass products | do | 7.5 | 7.1 | 7.1 |
| Chemicals and allied products | do | 13.2 | 13.1 | 12.5 |
| Petroleum and coal products | do | .8 | .8 | .9 |
| Construction | do | 89.3 | 101.4 | 114.5 |
| Transportation and public utilities | do | 88.0 | 87.1 | 90.1 |
| Wholesale and retail trade | do | 406.9 | 427.8 | 449.2 |
| Finance, insurance, real estate | do | 94.6 | 98.8 | 103.8 |
| Services | do | 386.5 | 413.4 | 440.5 |
| Government and government enterprises | do | 393.2 | 379.6 | 383.9 |
| Total | do | 1,675.8 | 1,724.1 | 1,801.7 |
| Personal income: | | | | |
| Total | millions | $52,521 | $57,083 | $62,906 |
| Per capita | | $12,299 | $13,279 | $14,464 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 40.0 | 41.0 |
| Total average hourly earnings, production workers | | $8.78 | $9.02 | $9.45 |

See footnotes at end of table.

**Table 3.—Indicators of Maryland business activity —Continued**

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Earnings by industry: | | | | |
| Farm income | millions | $283 | $250 | $374 |
| Nonfarm | do | $32,976 | $36,119 | $40,137 |
| Mining total | do | $52 | $46 | $51 |
| Nonmetallic minerals except fuels | do | $13 | $15 | $16 |
| Coal mining | do | $38 | $31 | $34 |
| Manufacturing total | do | $5,120 | $5,418 | $5,925 |
| Primary metal industries | do | $835 | $735 | $741 |
| Stone, clay, and glass products | do | $185 | $189 | $208 |
| Chemicals and allied products | do | $336 | $377 | $381 |
| Petroleum and coal products | do | $27 | $27 | $31 |
| Construction | do | $1,912 | $2,199 | $2,644 |
| Transportation and public utilities | do | $2,350 | $2,522 | $2,680 |
| Wholesale and retail trade | do | $5,665 | $6,226 | $6,986 |
| Finance, insurance, real estate | do | $1,752 | $2,063 | $2,377 |
| Services | do | $7,428 | $8,421 | $9,566 |
| Government and government enterprises | do | $8,587 | $9,097 | $9,761 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 21,085 | 39,799 | 36,302 |
| Value of nonresidential construction | millions | $910.5 | $963.4 | $1,368.3 |
| Value of State road contract awards | do | $219.9 | $250.1 | $331.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 1,158 | 1,379 | 1,480 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $171.0 | $199.4 | $241.7 |
| Value per capita | | $40 | $46 | $56 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

**Trends and Developments.**—The State's nonfuel minerals industry in 1984, as in 1983, showed significant gains in both production and value. The combined value of construction sand and gravel and crushed stone production was $141 million, 19% over that of 1983. Also, the value of cement shipments, calcined gypsum for wallboard manufacturing, and ball clay for the manufacture of floor and wall tiles and sanitary ware increased 25%, 12%, and 10%, respectively, over that of 1983. Sales of exfoliated vermiculite used in insulating fill and fireproofing increased 14%. Because these mineral commodities were used in residential and commercial construction, the State's construction industry appeared to have moved out of its recent doldrums and to have joined the general economic recovery. Also, employment in the State's contract construction increased to 114,500 in 1984, a 12.9% increase over that of 1983, while total nonagricultural employment only increased by 4.5%.

In the primary metals sectors of the State's economy, which included aluminum, copper, and iron and steel, participation in the general economic recovery ranged from "not at all" for copper to "somewhat" for iron and steel, and "excellent" for aluminum.

Operations remained curtailed at the copper processing plant of Kennecott Refining Corp. The Curtis Bay refinery near Baltimore remained closed following its shutdown in mid-1983. At the State's sole integrated steel mill at Sparrows Point, Bethlehem Steel Corp. shipped 25% more pig iron in 1984 than in 1983, whereas total U.S. shipment increased only 6% for the same period. According to the National Academy of Engineering, the Nation's steel industry had been declining for 25 years and had yet to hit bottom. Several more years of steel company mergers, mill shutdowns, and company bankruptcies were predicted before the industry stabilized and was scaled down to profitability. The quantity and value of primary aluminum production at the reduction plant of Eastalco Aluminum Co. in Frederick increased by an estimated 15% and 32%, respectively, over that of 1983 while total domestic production increased by 11%. Also, compared with 1983 levels, employment in the State's primary metal sector fell by 10% to 18,900 workers, while employment in fabricated metals increased by 1% to 8,700.

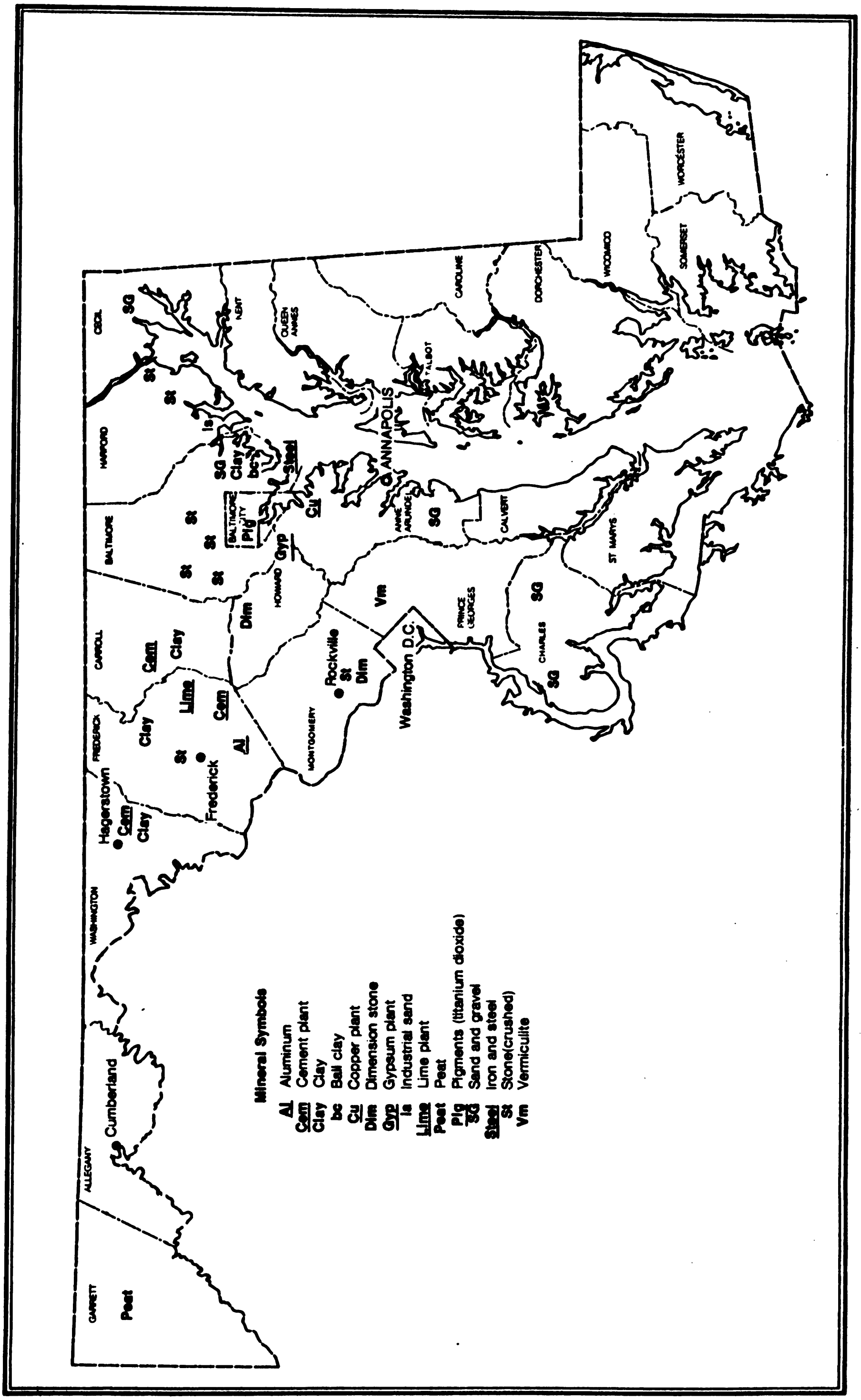

Figure 1.—Principal mineral producing localities in Maryland.

**Legislation and Government Programs.**—The Maryland Geological Survey (MGS) conducted applied research in hydrogeology and hydrology, environmental geology and mineral resources, coastal and estuarine geology, and archeology. MGS expenditures of $1.9 million in fiscal year 1984 were about equal to 1983 funding levels. Mineral resources aspects of the MGS programs included publication of two quadrangle geologic maps, an impact study of underground coal mining on surface and ground water, evaluations of mineral resource-mined land inventory, and geologic framework studies of Chesapeake Bay and the inner Continental Shelf. MGS also hosted the 20th Forum on the Geology of Industrial Minerals.

The U.S. Bureau of Mines conducted minerals and materials research at its Avondale Research Center in Prince Georges County. Major areas of mineral research include the fields of flotation, corrosion, electrodeposition, secondary metallurgy, characterization of metals and minerals, particulate mineralogy, and process evaluation. Its work was equally divided between basic and applied research.

**Foreign Oceanborne Commerce.**—The Port of Baltimore continued to maintain its position, second only to New York, as the most important container and general cargo port on the East Coast. Additionally, the downward trend of mineral commodities in overall foreign trade was reversed.

Export trade in coal, which in 1983 recorded its worst year, was 7.2 million short tons in 1984—a 5% increase over that of 1983. Coke exports (including asphalt, petroleum coke, and pitch) reached 61,000 tons, up 30% from that of 1983. Export trade in fertilizer and fertilizer materials was 2,000 tons in 1984, 60% over that of 1983.

Import trade in minerals and materials included alumina, clay, ferroalloys, fertilizer and fertilizer materials, gypsum, iron and manganese ores, miscellaneous ores and concentrates (including chrome ore), and petroleum and petroleum materials. All posted large gains in tonnage as import trade in these commodities reached 9.3 million tons, 51% over that of 1983.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Cement.**—Lehigh Portland Cement Co., a subsidiary of the West German company Heidelberger Zement AG, at Union Bridge, and Lone Star Cement Inc., at Hagerstown, produced portland and masonry cements. At Lime Kiln, Coplay Cement Co., a subsidiary of France's Société des Ciments Français, produced only portland cement. Shipments and value of both portland and masonry cement increased 14% and 25%, respectively, over that of 1983.

Also, Atlantic Cement Co. Inc., a wholly owned subsidiary of Newmont Mining Corp., produced slag cement at its plant at Sparrows Point. The company had processing facilities adjacent to the "L" blast furnace of Bethlehem Steel at Sparrows Point. Molten slag was tapped from the furnace and entered a blow box, where the hot slag falling into cold water was fractured and granulated. The slag, which at this point has a moisture content of about 6%, was conveyed to intermediate silos and later trucked to stockpiles near the processing facility from which it was conveyed by belt loader to the processing plant and dried in a fluid bed dryer. The slag was then finely ground in a ballmill and stored in two 20,000-short-ton-capacity inverted silos. The slag cement, called Newcem, was shipped by truck and barge to East Coast terminals from Massachusetts to South Carolina. Company-owned, oceangoing barges, having capacities of 17,000 tons, were used for transport. The $77 million plant, which began operation in mid-1982, had an annual capacity of 800,000 tons. The facility, which was run by 9 people per shift, operated 24 hours per day and 7 days per week with a total work force of 61 people.

The Union Bridge plant of Lehigh Portland was shut down for 24 days after the walkout of 160 union workers. The strike began on May 24 when the company rejected a proposed contract patterned after another union agreement with Lone Star Industries Inc., a cement company not related to Lehigh Portland. Late in the year, Coplay Cement, which also operates a cement plant in Nazareth, PA, acquired the Kentucky-based Louisville Cement Co. Louisville Cement operated plants at Speed and Logansport, IN.

**Clays.**—Common clay and shale was mined for the production of lightweight aggregate and the manufacture of bricks and portland cement. The quantity and value of the State's production decreased 28% and 15%, respectively, from that of 1983. Whereas, total U.S. production of common clay and shale for construction materials increased for the second consecutive year, reversing the downward trend that had persisted from 1978 to 1980. Total domestic production and value increased 8% and 12%, respectively, over that of 1983.

Ball clay was mined for the manufacture of wall and floor tiles, ceramics, and sanitary ware. Production remained unchanged from that of 1983, while value increased 10%. Maryland was one of only seven States that produced ball clay.

**Gypsum (Calcined).**—Crude gypsum imported from Canada was calcined by National Gypsum Co. and United States Gypsum Co. at plants in Baltimore for manufacturing wallboard. Production and value increased 8% and 12%, respectively, over that of 1983.

The SCM Pigments Div. of SCM Corp. in Baltimore was one of seven domestic companies in 1984 that sold a total of 780,000 short tons of byproduct gypsum, valued at $6.5 million, principally for agricultural use and also for wallboard manufacturing. Some byproduct gypsum, obtained from SCM, was mixed with natural gypsum and commercially used in the manufacture of wallboard at the Baltimore plant of U.S. Gypsum.

**Lime.**—At its Woodsboro plant in Frederick County, S. W. Barrick & Sons Inc. produced industrial and agricultural lime, as well as crushed limestone. Production at 7,000 short tons remained unchanged from that of 1983, but value increased by 9% to $419,000. Of total production, 4,000 tons was hydrated, and 3,000 tons was quicklime.

**Peat.**—Garrett County Processing & Packaging Corp. mined reed-sedge and humus peat near the town of Accident in the western corner of the State. About 85% of the processed material was sold in bulk for agricultural application. The remainder was packaged and sold as a soil conditioner under the trade name Free State Peat. Production increased by 25% to 4,500 short tons, and value increased 14%.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

A total of 14.2 million short tons of construction sand and gravel valued at $46.7 million, f.o.b. plant or mine, was produced in Maryland in 1984, an increase of 34% and 23%, respectively, over that of 1983. Production, as reported by the State's producers to the U.S. Bureau of Mines, was the material that was actually sold or used. Stockpiled production was not reported until it was sold or consumed.

In 1984, production was reported from 83 operations that included 41 with stationary and/or portable processing plants, 38 operations with no plants or not specified, and 4 dredging operations.

*Industrial.*—Harford Sands Inc., Joppa, produced industrial sands at its Magnolia operation in Harford County. Products included abrasive, filter, foundry, and specialty sands. Specialty sand was used in sand traps on golf courses, foundry sand was used for cores and molds for casting common metals, filter sand was used in treating water supplies, and abrasive sand was used for sandblasting.

**Slag—Iron and Steel.**—Two companies at processing facilities on the property of Bethlehem Steel at Sparrows Point produced water-granulated, air-cooled, and expanded iron slag. Another company, also at Sparrows Point, processed steel slag.

**Table 4.—Maryland: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Asphaltic concrete | 1,734 | $5,845 | $3.37 |
| Concrete aggregate | 4,446 | 13,942 | 3.14 |
| Concrete products | 959 | 2,879 | 3.00 |
| Fill | 1,696 | 4,761 | 2.81 |
| Plaster and gunite sands | 36 | 115 | 3.19 |
| Road base and coverings | 2,100 | 4,590 | 2.19 |
| Snow and ice control | 10 | 40 | 4.00 |
| Other | 3,252 | 14,498 | 4.46 |
| Total[1] or average | 14,234 | 46,671 | 3.28 |

[1] Data may not add to totals shown because of independent rounding.

Atlantic Cement produced a finely ground, water-granulated iron slag product called Newcem, a slag cement that is mixed in a 50-50 blend by weight with portland cement. The resultant concrete has a greater compressive strength, but has a longer curing time than concrete made with standard portland cement.

At its 5,000-short-ton-per-day plant, Maryland Slag Co. processed air-cooled and expanded iron slag into 15 different products. The company is presently operating under a contract with Bethlehem Steel to remove iron slag from Bethlehem Steel's "H," "J," and "K" blast furnaces, but since these furnaces were shut down, Maryland Slag has been recovering the iron slag that was previously dumped into the pits of the three furnaces. Atlantic Cement, which had exclusive rights to the slag from Bethlehem Steel's "L" furnace, has subcontracted with Maryland Slag to take slag from that furnace's four overflow pits. The air-cooled slag was crushed into various sizes for use for road base material and as a substitute for natural aggregate. For some applications, the advantage of crushed slag over natural aggregate was lower density—80 pounds per cubic foot in comparison to 140 pounds per cubic foot. The expanded slag was crushed and sold as lightweight concrete aggregate for use in manufacturing building blocks.

Processing for air-cooled iron slag began with the dumping of the molten material by ladle cars into one of three 1/2-mile-long slag pits. Each ladle car held two 20-ton ladles. The pit was filled in thin successive layers to allow for cooling. The solidified slag was processed after about a 6-week cooling period. Expanded iron slag was processed similarly except that water was sprayed into the hot slag creating steam, which fractured the slag. The fractured material was then excavated from the pit with bulldozers and dumped into a crusher. Free iron was separated from the slag in the pit using bulldozers and a 50-ton crane with a 50-inch circular magnet. Additional iron was removed from the crushed slag during processing using belt magnets. The reclaimed iron was sold as scrap to Bethlehem Steel.

In 1984, C. J. Langenfelder & Sons Inc. started operations under a contract with Bethlehem Steel to process steel slag from the basic oxygen and open-hearth furnaces. Maryland Slag acted as sales agent for the company and subleased part of the stockpile area to it.

The molten steel slag was carried from the furnaces in rubber-tired ladle carriers, dumped into a pit, and later excavated with bulldozers while still about 700° F. It was then crushed from 2-foot blocks to about a 4-inch size. The crushed slag was trucked to stockpiles where it was cured for at least 1 year to leach out the calcium and to allow for expansion. Cured steel slag was used as road base material.

Shipments and value of all iron blast furnace slag increased 12% and 42%, respectively, from 1983 levels, while total domestic sales and value increased 24% and 32%, respectively.

Nationally, the average unit price, f.o.b. plant, for all iron blast furnace slag was $5.09 per ton. Air-cooled iron slag was $4.33 per ton, and expanded iron slag was $11.49 per ton. The unit value of steel slag was $3.28 per ton. Price information from granulated slag was withheld to avoid disclosing company proprietary information.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—A total of 22.1 million short tons of crushed stone valued at $94 million, f.o.b. plant, was estimated to have been produced in 1984, an increase of 15% and 17%, respectively, over 1983 production.

The Arundel Corp., using low-interest rate industrial development bonds, began improving crushed stone quarrying operations at its Greenspring Quarry in Baltimore. The 15-year plan for the 360-acre site included sequential land use for residential development and an office park. Also, Rockville Crushed Stone Inc. proposed to open a stone quarry and processing plant on 500 of its 1,800 acres of land in the community of Boyd in Montgomery County.

Genstar Stone Products Co., the State's largest producer of crushed stone and 1 of the top 10 producers, mined white calcite by surface and underground methods from a high-purity layered marble member within its crushed stone quarry in Texas, 12 miles north of the Inner Harbor. Fillers, including ultrafines, were produced at the on-site plant and marketed throughout the Eastern United States and Canada for use in paint, plastics, paper, caulks and sealants, and adhesives.

*Dimension.*—A total of 221,000 cubic feet of dimension stone, valued at $864,000, f.o.b. plant, was estimated to have been produced in 1984. The 65,000-cubic-foot increase in quantity and the $182,000 increase in value represented 42% and 27% gains, respectively, over 1983 levels.

Production included granite gneiss, quartzite, sandstone (which was sold in irregular shapes), cut stone, rough blocks, flagging, and a small amount of veneer.

**Titanium Dioxide (Pigments).**—The pigment plant of SCM in Baltimore produced titanium dioxide pigments for use in lacquers, paint, paper, plastics, and varnishes. Annual plant capacity was 66,000 short tons by the sulfate process and 46,000 tons by the chloride process.

Total domestic production and consumption reached new record high levels in 1984 because of continued economic expansion and increased demand from the homebuilding industry. There was a 5% increase in production and a 3% increase in consumption over 1983 levels. Imports rose by 11%. Notable changes were increases in consumption for paints and plastics and a sharp decrease in consumption in paper.

**Vermiculite (Exfoliated).**—The Construction Products Div. of W. R. Grace & Co. at Muirkirk in Prince Georges County exfoliated South Carolina-mined vermiculite. Most of the production was used in insulating fill and Monokote fireproofing. Sales value increased 14% from that of 1983.

## METALS

**Aluminum.**—Alumax Inc., the fourth largest domestic aluminum producer, operated one of its three U.S. smelters in Frederick. The company's Eastalco reduction plant near Buckeystown in Frederick County has an annual rated capacity of 176,000 short tons, 29% of Alumax's domestic capacity.

As the economic recovery that began in mid-1983 continued into early 1984, Alumax continued to start up potlines at its Eastalco reduction plant, and by the end of January, production was up to 100% capacity. However, metal prices began to decline in January as U.S. and world inventories increased. To offset this trend, the Eastalco smelter, through selective pot shutdowns in October, went from operating 100% to 87% capacity, where it remained for the rest of the year as foreign sources of aluminum gained a larger share of the U.S. market and net imports rose to a record high.

In April, Kaiser Aluminum & Chemical Corp. resumed operations at its Halethorpe heavy-press extrusion plant following ratification of a 5-year labor agreement. The plant had been closed since October 1983 after the local union of the United Steelworkers of America rejected the company's offer of reduced wage and benefit concessions. The Halethorpe facility supplied extruded aluminum materials to the aerospace, aircraft, and transportation industries. The new labor agreement allowed the reopened plant to more effectively meet competition in those markets.

**Copper.**—Operations remained curtailed at Kennecott's refinery near Baltimore. The plant had been shutdown since mid-1983. Prior to its shutdown, the refinery had been processing primary toll material and had been on a reduced work schedule since January 1983. The refinery, using the electrolytic process and mostly primary feed, had produced cathode and rod. It had an available annual capacity of 200,000 metric tons.

For the domestic industry, 1984 was a paradoxical year. Prices fell sharply to the lowest level since the 1940's in real terms. While production was stable, shipments increased and inventories declined. The average producers price for cathode of 66.85 cents per pound was the lowest average for the past 5 years, yet deliveries to customers as reported by the American Bureau of Metal Statistics were almost 12% higher than in 1983 and came close to matching the deliveries reported in 1979, the industry's previous record year. Also, compared with that of 1979, U.S. mine, smelter, and refinery production were sharply reduced, while similar data for the rest of the world indicated greater output.

In March, American Telephone & Telegraph Co. (AT&T) initiated the planned shutdown of its Baltimore copper cable and wire plant, citing increased use of fiber optics in lieu of copper in telecommunications. The phaseout of AT&T's Baltimore Works over a 12- to 18-month period was expected to affect 3,500 workers. A partial cutback in 1983 reduced the plant's work force by 1,353, including 450 layoffs and 370 transfers to other AT&T facilities.

**Iron and Steel.**—The year 1984 witnessed a revival in the U.S. steel industry as raw steel output increased by 11% over that of 1983. The revival was strong for the first 5 months of the year, as operating rates rose as high as 80% of capacity in March, April, and May. Output held up well through June. However, in the second half of the year, production fell significantly and continually from July through December, which registered the lowest volume of the year.

Construction activity at the Sparrows Point plant of Bethlehem Steel Corp. peaked in September with about 500 tradespeople working on the $250 million continuous slab caster that was scheduled to start up in the first quarter of 1986. A second slab caster at Burns Harbor, IN, was scheduled to go into operation in the second quarter of 1986. Along with the caster at the company's Steelton, PA, plant, the four would be able to cast about 60% to 65% of Bethlehem's semifinished steel requirements. Continuous casters were expected to improve quality, increase yield, provide significant energy savings, and increase productivity. Continuous casting produces steel with excellent surface and internal qualities, which led to improved quality of plates, rails, rods, sheets, and tinplate. The company also announced plans to spend $60 million to upgrade plate, steel, and tin mills and a Galvalume sheet line at Sparrows Point. At midyear, two blast furnaces were continuing production and four open-hearth furnaces and two basic oxygen furnaces (BOF) were converting iron to steel. However, at yearend, the Sparrows Point plant was operating with only its "L" blast furnace and one BOF. Sluggish steel sales prompted the shutdown of furnaces. The resulting 400-worker layoff left the plant with 2,400 on indefinite layoff and about 11,000 employees on the payroll.

*Stainless Steel.*—The Baltimore Works of Ohio-based Armco Inc. produced stainless steel, vacuum-refined alloy steel in ingots, forging billets, bar, rod, and wire, and specialty shapes. It was the company's main stainless steel plant and had the third largest market share in the industry.

Eastern Stainless Steel Co. (ESS), a division of Eastmet Corp., produced stainless steel in coils, flat bar, plates, sheet, and strip. The Baltimore-based company was the largest domestic producer of stainless plate. At yearend, in light of its weak financial performance, Eastmet was exploring, with the help of an investment banking firm, options ranging from raising capital to selling the company. Eastmet had a third quarter net loss of $7.9 million—more than twice the loss of the previous year. The company attributed the loss to its problems in producing stainless steel plate and "a softening in the market for stainless steel products and accompanying price erosion." A defective cooling mechanism on the continuous caster was creating serious surface defects in heavy gauge plate, requiring extensive reworking to bring the steel up to commercial quality. Plate accounted for about one-half of ESS's production with most of the other one-half consisting of stainless steel sheet. During September, ESS operated at only 60% of capacity, compared with 85% in June. Also in September, the facility was shut down for a week because of poor demand.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum: | | | |
| Eastalco Aluminum Co. (Alumax Inc.). | 5601 Manor Woods Rd.<br>Frederick, MD 21701 | Reduction plant | Frederick. |
| Cement: | | | |
| Portland: | | | |
| Coplay Cement Co. (Société des Ciments Français).[1] | 4120 Buckeystown Pike<br>Lime Kiln, Box D<br>Frederick, MD 21701 | Quarry and plant. | Do. |
| Portland and masonry: | | | |
| Lehigh Portland Cement Co. (Heidelberger Zement AG)[1] [2] | Box L<br>Union Bridge, MD 21791 | do | Carroll. |
| Lene Star Cement Inc.[1] | Box 650<br>Hagerstown, MD 21740 | do | Washington. |
| Clays: | | | |
| Ball clay: | | | |
| Cyprus Industrial Minerals Co., Cyprus Mines Corp. | 9420 Pulaski Highway<br>Baltimore, MD 21220 | Pit and plant | Baltimore. |
| Common clay: | | | |
| Baltimore Brick Co | 9801 Rocky Ridge Rd.<br>Rocky Ridge, MD 21778 | do | Frederick. |
| Lehigh Portland Cement Co | Box L<br>Union Bridge, MD 21791 | Pits and plant | Carroll and Frederick. |
| Victor Cushwa & Sons Inc | Clearspring Rd. & Route 68N<br>Box 160<br>Williamsport, MD 21795 | Pits | Washington. |

See footnotes at end of table.

## Table 5.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Copper: | | | |
| Kennecott Refining Corp.[3] | Kenbo Rd.<br>Curtis Bay, MD 21226 | Refinery | Anne Arundel. |
| Gypsum: | | | |
| Byproduct: | | | |
| SCM Corp., SCM Pigments Div. | 3901 Glidden Rd.<br>Baltimore, MD 21226 | Plant | Baltimore. |
| Calcined: | | | |
| National Gypsum Co., Gold Bond Building Products. | 2301 South Newkirk St.<br>Baltimore, MD 21224 | do | Do. |
| United States Gypsum Co | 500 Quarantine Rd.<br>Box 3472<br>Baltimore, MD 21226 | do | Do. |
| Iron and steel: | | | |
| Armco Inc., Stainless Steel Div. | 3501 East Biddle St.<br>Box 1697<br>Baltimore, MD 21203 | Mill | Do. |
| Bethlehem Steel Corp | Sparrows Point, MD 21219 | Mill (integrated) | Do. |
| Eastern Stainless Steel Co., a division of Eastmet Corp. | 7700 Rolling Mill Rd.<br>Dundalk, MD 21222<br>Box 1975<br>Baltimore, MD 21203 | Mill | Do. |
| Lime: | | | |
| S. W. Barrick & Sons Inc.[1] | Woodsboro, MD 21798 | Quarry and plant. | Frederick. |
| Peat: | | | |
| Garrett County Processing & Packaging Corp. | RFD 1<br>Accident, MD 21520 | Bog | Garrett. |
| Sand and gravel: | | | |
| Construction: | | | |
| Charles County Sand & Gravel Co. Inc. | Waldorf Industrial Center<br>Box 548<br>Waldorf, MD 20601 | Pits and plants | Anne Arundel, Charles, St. Marys. |
| Genstar Stone Products Co.[4] | Executive Plaza 4<br>11350 McCormick Rd.<br>Hunt Valley, MD 21031 | do | Baltimore. |
| Silver Hill Sand Gravel & Concrete Co. | 4714 St. Barnabus Rd. SE.<br>Temple Hills, MD 20748 | do | Prince Georges. |
| York Building Products Co. Inc. | 910 Old Philadelphia Rd.<br>Aberdeen, MD 20820 | do | Cecil. |
| Industrial: | | | |
| Harford Sands Inc.[5] | Box 25<br>40 Fort Hoyle Rd.<br>Joppa, MD 21085 | do | Harford. |
| Slag: | | | |
| Iron: | | | |
| Atlantic Cement Co. Inc | Box 6687<br>Sparrows Point, MD 21219 | Plant | Do. |
| Maryland Slag Co. (The Arundel Corp.) | Sparrows Point, MD 21219 | do | Do. |
| Steel: | | | |
| C. J. Langenfelder & Sons Inc | 8427 Pulaski Highway<br>Baltimore, MD 21221 | do | Do. |
| Stone: | | | |
| Crushed: | | | |
| The Arundel Corp | 110 West Rd.<br>Baltimore, MD 21204 | Quarries and plants. | Baltimore, Frederick, Harford. |
| Genstar Stone Products Co | Executive Plaza 4<br>11350 McCormick Rd.<br>Hunt Valley, MD 21031 | do | Baltimore, Carroll, Frederick, Harford. |
| Rockville Crushed Stone Inc | Box 407<br>13900 Piney Meetinghouse Rd.<br>Rockville, MD 20850 | Quarry and plant. | Montgomery. |
| Dimension: | | | |
| Butler Artcraft Stone Corp | 1611 St. Paul St.<br>Hampstead, MD 21074 | do | Baltimore. |
| Piccirilli Quarries | 795 Marriottsville Rd.<br>Marriottsville, MD 21164 | do | Howard. |
| Stoneyhurst Quarries | Box 34463<br>8101 River Rd.<br>Bethesda, MD 20817 | do | Montgomery. |
| Titanium dioxide (pigments): | | | |
| SCM Corp., SCM Pigments Div | 3901 Glidden Rd.<br>Baltimore, MD 21226 | Chemical plant | Baltimore. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co., Construction Products Div. | 12340 Conway Rd.<br>Beltsville, MD 20705 | Plant | Prince Georges. |

[1] Also crushed stone.
[2] Also common clay and shale.
[3] Shut down since mid-1983.
[4] Also calcite.
[5] Also construction sand and gravel.

# The Mineral Industry of Massachusetts

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Massachusetts Department of Environmental Quality, Office of the State Geologist, for collecting information on all nonfuel minerals.**

### By L. J. Prosser, Jr.,[1] and Joseph A. Sinnott[2]

The value of nonfuel mineral production in Massachusetts surpassed the $100 million level in 1984 for the first time in the State's history. Demand, primarily from the construction industry, resulted in a 24% increase in the combined output of the State's four principal construction mineral commodities.

**Table 1.—Nonfuel mineral production in Massachusetts[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | 237 | $1,298 | 240 | $1,212 |
| Lime do. | 156 | 10,671 | 171 | 12,426 |
| Sand and gravel (construction) do. | $^{e}$10,400 | $^{e}$36,200 | 14,168 | 42,139 |
| Stone: | | | | |
| Crushed do. | 7,740 | 36,002 | $^{e}$8,400 | $^{e}$39,000 |
| Dimension do. | 51 | 10,488 | $^{e}$57 | $^{e}$11,657 |
| Combined value of gem stones, peat, and sand and gravel (industrial) | XX | 1,016 | XX | 898 |
| Total | XX | 95,675 | XX | 107,332 |

$^{e}$Estimated. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Massachusetts, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Barnstable | $1,655 | (2) | |
| Berkshire | 10,624 | W | Lime, stone (crushed), stone (dimension). |
| Bristol | 2,662 | W | Stone (crushed). |
| Dukes | 27 | (2) | |
| Essex | 1,115 | $4,342 | Stone (crushed). |
| Franklin | W | W | Do. |
| Hampden | 2,378 | W | Do. |
| Hampshire | 552 | W | Do. |
| Middlesex | W | 16,367 | Stone (dimension), stone (crushed), sand and gravel (industrial). |
| Norfolk | W | W | Stone (crushed), clays. |
| Plymouth | W | 1,377 | Clays, sand and gravel (industrial), stone (dimension). |
| Suffolk | (3) | W | Stone (crushed). |
| Worcester | W | W | Stone (crushed), peat. |
| Undistributed[4] | 27,632 | 37,389 | |
| Sand and gravel (construction) | XX | [e]36,200 | |
| Stone: | | | |
| Crushed | [e]33,500 | XX | |
| Dimension | [r] [e]11,399 | XX | |
| Total | [r] [5]91,543 | 95,675 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Massachusetts business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 5,750 | 5,763 | 5,798 |
| Total civilian labor force | do | 3,000 | 2,978 | 3,051 |
| Unemployment | do | 237 | 205 | 145 |
| Employment (nonagricultural): | | | | |
| Mining total | do | 1.1 | 1.0 | 1.1 |
| Manufacturing total | do | 640.1 | 632.9 | 675.9 |
| Primary metal industries | do | 15.4 | 15.0 | 16.3 |
| Stone, clay, and glass products | do | 11.8 | 11.3 | 11.9 |
| Chemicals and allied products | do | 17.2 | 16.8 | 17.6 |
| Petroleum and coal products[1] | do | 1.6 | 1.4 | NA |
| Construction | do | 78.4 | 82.6 | 96.1 |
| Transportation and public utilities | do | 120.1 | 118.2 | 122.9 |
| Wholesale and retail trade | do | 577.0 | 610.3 | 657.9 |
| Finance, insurance, real estate | do | 168.7 | 171.8 | 177.4 |
| Services | do | 682.0 | 704.3 | 750.7 |
| Government and government enterprises | do | 370.7 | 371.4 | 369.7 |
| Total | do | [2]2,638.0 | 2,692.5 | 2,851.7 |
| Personal income: | | | | |
| Total | millions | $70,626 | $76,746 | $85,709 |
| Per capita | | $12,283 | $13,318 | $14,784 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 39.9 | 40.1 |
| Total average hourly earnings, production workers | | $7.58 | $8.01 | $8.50 |
| Earnings by industry: | | | | |
| Farm income | millions | $149 | $148 | $172 |
| Nonfarm | do | $50,289 | $55,495 | $62,556 |
| Mining total | do | $26 | $27 | $32 |
| Manufacturing total | do | $14,433 | $15,415 | $17,598 |
| Primary metal industries | do | $383 | $340 | $384 |
| Stone, clay, and glass products | do | $277 | $287 | $329 |
| Chemicals and allied products | do | $488 | $483 | $567 |
| Petroleum and coal products | do | $60 | $57 | $65 |
| Construction | do | $2,037 | $2,326 | $2,817 |
| Transportation and public utilities | do | $3,234 | $3,498 | $3,688 |
| Wholesale and retail trade | do | $7,806 | $8,814 | $10,218 |
| Finance, insurance, real estate | do | $3,438 | $3,947 | $4,455 |
| Services | do | $12,320 | $13,940 | $15,709 |
| Government and government enterprises | do | $6,818 | $7,305 | $7,796 |

See footnotes at end of table.

Table 3.—Indicators of Massachusetts business activity —Continued

| | 1982r | 1983 | 1984p |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 15,469 | 23,007 | 27,450 |
| Value of nonresidential construction millions | $997.0 | $1,106.2 | $1,627.8 |
| Value of State road contract awards do | $307.0 | $125.0 | $228.6 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,023 | 1,111 | 1,336 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $91.5 | $95.7 | $107.3 |
| Value per capita | $16 | $17 | $19 |

pPreliminary. rRevised. NA Not available.

[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[2] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

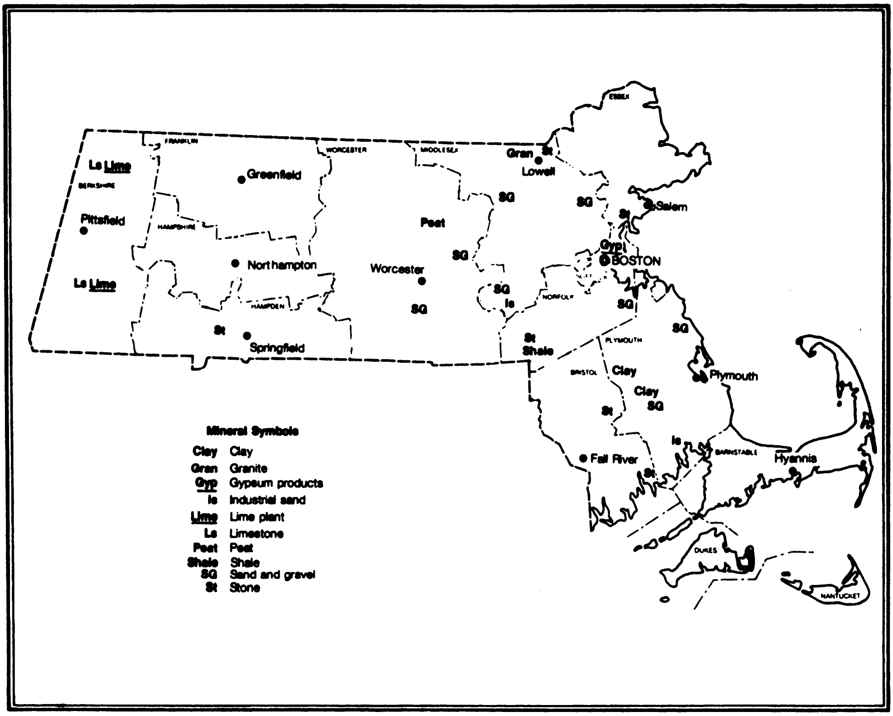

Figure 1.—Principal mineral producing localities in Massachusetts.

**Trends and Developments.**—Output from the State's mineral producers in 1984 was indicative of the demand for industrial minerals during an economic upswing. Clays, lime, construction sand and gravel, and crushed stone production increased compared with 1983 totals and surpassed the average output totals of the past 5 years. Housing starts, one indicator of improved economic conditions, increased significantly. The relationship between mineral production and construction activity is exemplified in the following table.

**Table 4.—Massachusetts: Mineral production and construction activity**

| Year | Clays (thousand short tons) | Lime (thousand short tons) | Sand and gravel (construction) (thousand short tons) | Stone (crushed) (thousand short tons) | Housing starts[1] |
|---|---|---|---|---|---|
| 1980 | 210 | 180 | 13,925 | 7,316 | 20,609 |
| 1981 | 259 | 170 | [e]12,500 | 7,997 | 19,627 |
| 1982 | 210 | 135 | 12,003 | [e]6,900 | 20,030 |
| 1983 | 237 | 156 | [e]10,400 | 7,740 | 22,788 |
| 1984 | 240 | 171 | 14,168 | [e]8,400 | 28,860 |

[e] Estimated.

[1] Federal Reserve Bank of Boston. New England Economic Indicators, 1984 Index. Dec. 1984, p. B8.

**Legislation and Government Programs.**—The Massachusetts Office of the State Geologist, Department of Environmental Quality, continued as the primary source of information on the mineral resources and geology of the State. Among the cooperative projects with the Office of the State Geologist was a U.S. Geological Survey (USGS) evaluation of the environmental effects of deep-water drilling that included monitoring operations of Georges Bank off the Massachusetts coast. The study identified barite, a major element in drilling mud, as the only trace metal contaminant stemming from offshore drilling. Exploration of Georges Bank ceased in 1982 when attempts to discover oil and gas proved unsuccessful.

Compilation of a surficial geology map of the State by the USGS, which began in 1940, continued in 1984; completion of the map was expected by 1986. Published during the year were bedrock geologic maps of the Monterey and Pittsfield East Quadrangles in Berkshire County.

Research continued at the Massachusetts Institute of Technology in Cambridge with reauthorization of the Mining and Mineral Resources and Research Institute program for 5 years.

During the year, the U.S. Bureau of Mines signed a research contract with Foster-Miller Inc. of Waltham to develop better techniques for control of respirable quartz dust in underground coal mines. The 4-year contract is aimed at finding methods of lowering exposure to dust generated by two types of continuous mining equipment.

Another Bureau project involved development of a general beneficiation flowsheet for recovery of silicon carbide from granite waste sludge. Samples from a Massachusetts dimension granite operation produced concentrates containing 97.7% silicon carbide using a creosote-cresylic acid flotation scheme.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Abrasives.**—Norton Co., Worcester, was one of five U.S. companies that manufactured nonmetallic crude artificial abrasives in 1984. In Northboro, Norton began construction of a 100,000-square-foot, $10 million research and development facility for its ceramics division. The facility is scheduled for completion in early 1985 with eventual employment of 130. Manufacture of pilot-line quantities of aluminum oxide powder designed for magnetic media applications continued at the Northboro site.

Washington Mills Abrasive Co., North Grafton, processed emery purchased from the DeLucca Mine near Peekskill, NY, and fused aluminum oxide from a company-owned plant in Ontario, Canada.

General Abrasives Div. of Dresser Industries Inc. continued operations at two plants in Massachusetts. Natural abrasive corundum, fused aluminum oxide, and silicon carbide powders were processed at the Westfield plant. High-quality Turkish emery was processed at the Chester plant.

**Clays.**—In 1984, two companies mined common clay for brick manufacture in Plymouth County, and a third mined anthracite-bearing shales in Norfolk County for manufacture of lightweight aggregate. The State again accounted for about three-fifths of the New England region's clay and shale production.

**Graphite (Manufactured).**—The Stackpole Corp. and Avco Corp., which were acquired by Textron Corp. in 1984, produced high-modulus graphite fibers in Middlesex County. Domestic output of high-modulus fiber in the past decade increased from 48 to 1,174 short tons. Massachusetts accounted for over 15% of the 1984 U.S. production of this fiber, which was sold primarily to the aerospace industry.

**Gypsum (Calcined).**—United States Gypsum Co. near Boston imported gypsum from company-owned mines in Canada. The crude gypsum was crushed and calcined for use in wallboard manufacture, and the finished board was shipped throughout New England for use in construction.

**Lime.**—The State's lime industry consisted of two companies operating in Berkshire County in western Massachusetts. These were the only two lime manufacturing operations in New England since the closing of Pfizer Inc.'s lime plant in Connecticut early in 1984.

About 90% of the output in 1984 was quicklime, and 10% was hydrated lime. The lime was used by the agricultural, chemical, and construction industries.

**Peat.**—Sterling Peat Co., Worcester County, in north-central Massachusetts, was the State's sole peat producer. Reedsedge peat was mined and sold mostly for agricultural applications.

**Perlite (Expanded).**—Whittemore Products Inc. expanded perlite at the company's facility in Andover, Essex County. Shipped by rail from New Mexico, the perlite was used in insulation materials and for horticultural applications. In 1984, the firm sold 2,300 short tons of expanded perlite valued at $779,000.

**Sand and Gravel.**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Production increased after 3 consecutive years of decline, reflecting improved conditions in the construction industry. The 14.2 million short tons produced in 1984 was significantly higher than the 10.4 million tons produced in 1983. However, 1984 output was still well below the 18-million-ton average level of production recorded in the early 1970's. Construction aggregate shipped from other New England States, particularly New Hampshire, has increased in the past few years, supplementing Massachusetts' production.

**Table 5.—Massachusetts: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,401 | $13,705 | $4.03 |
| Plaster and gunite sands | W | W | 4.96 |
| Concrete products | 133 | 566 | 4.25 |
| Asphaltic concrete | 739 | 2,558 | 3.46 |
| Road base and coverings[1] | 1,769 | 4,205 | 2.38 |
| Fill | 1,748 | 3,359 | 1.92 |
| Snow and ice control | 434 | 1,134 | 2.61 |
| Railroad ballast | W | W | 5.68 |
| Other[2] | 5,944 | 16,611 | 2.79 |
| Total or average | 14,168 | [3]42,139 | 2.97 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes road and other stabilization (cement).

[2] Includes roofing granules, other unspecified uses, and uses indicated by symbol W.

[3] Data do not add to total shown because of independent rounding.

During the year, R. M. Packer Co. Inc. began construction of a $250,000 roll-on-roll-off bulk water transport ramp in New Bedford for shipping sand and gravel, stone, and other building materials. When completed, trucks hauling 30-ton loads will unload aggregate into 300- to 1,000-ton-capacity barges for shipment to Martha's Vineyard, Nantucket, Cuttyhunk, Block Island, and Long Island for use in construction projects. The facility, which was termed one of the largest and most capable in New England by the New Bedford Harbor Development Commission, was an indication of the continuing demand for mineral aggregate by the island communities along Massachusetts' southern coast.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Output in 1984 of 8.4 million short tons was the third highest total reported in the State's history. As mentioned previously for other commodities used in construction, demand from that industry provided the impetus for the increased production. Traditionally, about three-fourths of the output is traprock; granite and limestone are also mined.

*Dimension.*—Nationally, Massachusetts ranked seventh among the 32 States producing dimension stone. Dimension granite was mined in Berkshire, Middlesex, and Plymouth Counties and sold primarily for curbing.

**Vermiculite (Exfoliated).**—W. R. Grace & Co. exfoliated vermiculite at its Easthampton plant in Hampshire County. Output remained about the same in 1984 compared with that of 1983. Major uses were for insulation and fireproofing.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] State geologist, Massachusetts Department of Environmental Quality, Boston, MA.

### Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays: | | | |
| K-F Brick Co. Inc | River St.<br>Middleboro, MA 02346 | Pit | Plymouth. |
| Plainville Corp., Masslite Div.[1] | Box 327<br>Walpole, MA 02081 | Pit | Norfolk. |
| Stiles & Hart Brick Co | Box 367<br>Bridgewater, MA 02324 | Pit | Plymouth. |
| Gypsum (calcined): | | | |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | Plant | Suffolk. |
| Lime: | | | |
| Lee Lime Corp.[2] | Marble St.<br>Lee, MA 01238 | Plant and quarry. | Berkshire. |
| Pfizer Inc.[2] | 260 Columbia St.<br>Adams, MA 01220 | do | Do. |
| Peat: | | | |
| Sterling Peat Co | Sterling Junction, MA 01565 | Bog | Worcester. |
| Perlite (expanded): | | | |
| Whittemore Products Inc | Dundee Park<br>Andover, MA 01810 | Plant | Essex. |
| Sand and gravel: | | | |
| Construction: | | | |
| E. L. Dauphinais Inc | 160 Worcester St., Box 488<br>North Grafton, MA 01536 | Pits | Worcester. |
| Kimball Sand Co. Inc | Providence Rd., Box 29<br>Mendon, MA 01756 | do | Do. |
| S. M. Lorusso & Sons Inc | 331 West St.<br>Walpole, MA 02081 | do | Norfolk. |
| Rosenfeld Washed Sand & Stone Co. | Drawer E<br>Milford, MA 01757 | Pits | Worcester. |
| San-Vel Concrete Corp | Ayer Rd.<br>Littleton, MA 01460 | Pit | Middlesex. |
| Industrial: | | | |
| Holliston Sand Co. Inc | 303 Lowland St., Box 97<br>Holliston, MA 01746 | Pit | Do. |
| Whitehead Bros. Co | Box 259<br>Leesburg, NJ 08327 | Pit | Plymouth. |
| Stone: | | | |
| Crushed: | | | |
| John S. Lane & Son Inc | 730 East Mountain Rd.<br>Westfield, MA 01085 | Quarries | Berkshire, Hampden, Hampshire. |
| S. M. Lorusso & Sons Inc | 331 West St.<br>Walpole, MA 02081 | do | Middlesex, Norfolk, Suffolk. |
| Simeone Corp | 1185 Turnpike St.<br>Stoughton, MA 02072 | do | Bristol and Norfolk. |
| Tilcon Inc | Box 114<br>Acushnet, MA 02743 | Quarry | Bristol. |
| Trimount Bituminous Products Co. | 1935 Revere Beach Parkway<br>Everett, MA 02149 | Quarries | Essex. |
| Dimension: | | | |
| H. E. Fletcher Co | West Chelmsford, MA 01863 | Quarry | Middlesex. |
| Williams Stone Co. Inc | Box 278<br>East Otis, MA 01029 | do | Berkshire. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 62 Whittemore Ave.<br>Cambridge, MA 02140 | Plant | Hampshire. |

[1] Also sand and gravel.

[2] Also stone.

# The Mineral Industry of Michigan

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division, Michigan Department of Natural Resources, for collecting information on all nonfuel minerals.**

**By James J. Hill[1] and Wanda J. West[2]**

Nonfuel mineral production in Michigan was valued at $1.4 billion in 1984, an increase of 19% over the $1.2 billion reported in 1983. This was the second consecutive year that the value of the State's mineral output increased, as Michigan's economy continued to recover from the recessionary years of 1981-82. The State ranked sixth nationally in value of nonfuel mineral production and accounted for approximately 6% of the U.S. total. Michigan led the Nation in production of calcium chloride and magnesium compounds and in shipments of crude iron oxide pigments. The State ranked second in production of bromine, iodine, iron ore, peat, and industrial sand; third in production of crude gypsum and construction sand and gravel; and fourth in shipments of portland cement and pig iron. In order of value, the State's leading mineral commodities were iron ore, portland cement, magnesium compounds, salt, crushed stone, and calcium chloride. Output increased for most commodities pro-

**Table 1.—Nonfuel mineral production in Michigan[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | 1,199 | $5,693 | 1,321 | $5,052 |
| Gem stones | NA | 15 | NA | 15 |
| Gypsum thousand short tons | 1,097 | 8,104 | 1,534 | 10,304 |
| Iron ore (usable) thousand long tons, gross weight | 10,713 | W | 13,263 | W |
| Lime thousand short tons | 503 | 23,142 | 622 | 30,092 |
| Peat do | 215 | 4,286 | 227 | 4,341 |
| Salt do | 1,355 | 93,306 | 1,491 | 93,860 |
| Sand and gravel: | | | | |
| Construction do | [e]23,000 | [e]52,300 | 36,071 | 76,540 |
| Industrial do | 3,545 | 27,577 | 3,400 | 33,060 |
| Stone: | | | | |
| Crushed do | 24,763 | 82,152 | [e]28,100 | [e]92,000 |
| Dimension do | 4 | 112 | [e]4 | [e]129 |
| Combined value of bromine, calcium chloride, cement, iodine, iron oxide pigments (crude), magnesium compounds, and values indicated by symbol W | XX | [r]882,239 | XX | 1,063,214 |
| Total | XX | [r]1,178,926 | XX | 1,408,607 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Michigan, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Alcona | $83 | (2) | |
| Alger | 17 | (2) | |
| Allegan | W | W | Stone (crushed). |
| Alpena | W | W | Cement, stone (crushed), clays. |
| Antrim | W | W | Clays. |
| Arenac | 26 | $293 | Stone (crushed). |
| Baraga | 297 | W | Do. |
| Barry | 485 | W | Do. |
| Bay | 9,495 | W | Cement, lime, stone (crushed). |
| Benzie | 80 | (2) | |
| Berrien | W | W | Sand (industrial). |
| Branch | 533 | 5 | Stone (crushed). |
| Calhoun | 511 | W | Do. |
| Cass | 378 | W | Do. |
| Charlevoix | 29,716 | W | Cement, stone (crushed). |
| Cheboygan | 29 | W | Stone (crushed), peat. |
| Chippewa | 322 | W | Stone (crushed). |
| Clare | 320 | (2) | |
| Clinton | W | W | Clays. |
| Delta | 498 | 32 | Stone (crushed). |
| Dickinson | W | W | Iron ore, stone (crushed). |
| Eaton | W | W | Peat, stone (dimension). |
| Emmet | W | (2) | |
| Genesee | W | (2) | |
| Gladwin | 4 | (2) | |
| Gogebic | 82 | (2) | |
| Grand Traverse | 53 | (2) | |
| Gratiot | 304 | (2) | |
| Hillsdale | 874 | (2) | |
| Houghton | W | 27 | Stone (crushed). |
| Huron | W | W | Stone (crushed), lime. |
| Ingham | W | W | Peat. |
| Ionia | 71 | (2) | |
| Iosco | W | W | Gypsum. |
| Iron | 174 | (2) | |
| Isabella | 985 | (2) | |
| Jackson | 272 | W | Stone (dimension), stone (crushed). |
| Kalamazoo | 1,827 | W | Stone (crushed). |
| Kalkaska | 7 | (2) | |
| Kent | W | W | Peat, gypsum. |
| Keweenaw | 44 | (2) | |
| Lake | W | (2) | |
| Lapeer | W | W | Peat, calcium chloride. |
| Leelanau | W | (2) | |
| Lenawee | W | (2) | |
| Livingston | 2,804 | (2) | |
| Luce | 60 | (2) | |
| Mackinac | 183 | W | Stone (crushed). |
| Macomb | 4,596 | W | Sand (industrial). |
| Manistee | 101,431 | 111,961 | Magnesium compounds, salt, bromine. |
| Marquette | W | W | Iron ore, stone (crushed), iron oxide pigments. |
| Mason | W | W | Calcium chloride, magnesium compounds, bromine, lime, sand (industrial). |
| Mecosta | W | W | Peat. |
| Menominee | 268 | (2) | |
| Midland | W | W | Calcium chloride, magnesium compounds, bromine, iodine. |
| Missaukee | 51 | (2) | |
| Monroe | W | W | Cement, stone (crushed), clays, peat. |
| Montcalm | 142 | (2) | |
| Muskegon | W | W | Sand (industrial), salt. |
| Newaygo | W | (2) | |
| Oakland | W | 173 | Peat. |
| Oceana | W | W | Sand (industrial). |
| Ogemaw | 853 | (2) | |
| Ontonagon | W | (2) | |
| Osceola | W | (2) | |
| Otsego | 80 | (2) | |
| Ottawa | W | W | Sand (industrial). |
| Presque Isle | 617 | W | Stone (crushed), stone (dimension). |
| Roscommon | 12 | (2) | |
| Saginaw | W | W | Sand (industrial), lime. |
| St. Clair | W | W | Salt. |
| St. Joseph | W | W | Peat. |
| Sanilac | W | W | Peat, lime. |
| Schoolcraft | (3) | W | Stone (crushed), stone (dimension). |
| Shiawassee | 1,875 | W | Peat, clays. |

See footnotes at end of table.

### Table 2.—Value of nonfuel mineral production in Michigan, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Tuscola | W | W | Sand (industrial), lime. |
| Van Buren | $447 | (2) | |
| Washtenaw | 2,175 | (2) | |
| Wayne | 53,774 | $55,485 | Lime, cement, stone (crushed), salt, sand (industrial). |
| Wexford | W | 2,182 | Sand (industrial). |
| Undistributed[4] | [r]751,119 | 956,470 | |
| Sand and gravel (construction) | XX | [e]52,300 | |
| Stone: | | | |
| Crushed | [e]67,100 | XX | |
| Dimension | [r][e]95 | XX | |
| Total | [r]1,035,169 | [5]1,178,926 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]Crawford, Montmorency, and Oscoda Counties are not listed because no nonfuel mineral production was reported.

[2]Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3]Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

### Table 3.—Indicators of Michigan business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 9,116 | 9,050 | 9,075 |
| Total civilian labor force | do | 4,278 | 4,287 | 4,359 |
| Unemployment | do | 661 | 608 | 488 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 10.4 | 9.0 | 9.4 |
| Metal mining[2] | do | 3.0 | 2.3 | NA |
| Nonmetallic minerals except fuels[2] | do | 2.7 | 2.5 | NA |
| Oil and gas extraction[2] | do | 4.6 | 4.1 | NA |
| Manufacturing total | do | 876.9 | 880.5 | 945.8 |
| Primary metal industries | do | 51.1 | 49.5 | 52.7 |
| Stone, clay, and glass products | do | 15.1 | 15.7 | 15.9 |
| Chemicals and allied products | do | 41.7 | 39.8 | 40.0 |
| Petroleum and coal products | do | 3.2 | 3.0 | 2.3 |
| Construction | do | 89.5 | 86.5 | 89.2 |
| Transportation and public utilities | do | 143.3 | 139.4 | 138.5 |
| Wholesale and retail trade | do | 693.2 | 711.5 | 743.6 |
| Finance, insurance, real estate | do | 151.9 | 151.4 | 153.8 |
| Services | do | 650.3 | 675.0 | 696.5 |
| Government and government enterprises | do | 577.8 | 569.8 | 566.5 |
| Total | do | 3,193.3 | 3,223.1 | 3,343.3 |
| Personal income: | | | | |
| Total | millions | $97,929 | $104,017 | $114,017 |
| Per capita | | $10,743 | $11,493 | $12,607 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 40.2 | 42.5 | 43.2 |
| Total average hourly earnings, production workers | | $11.18 | $11.62 | $12.18 |
| Earnings by industry: | | | | |
| Farm income | millions | $686 | $685 | $823 |
| Nonfarm | do | $68,462 | $73,225 | $81,562 |
| Mining total | do | $320 | $273 | $303 |
| Metal mining | do | $96 | $83 | $93 |
| Nonmetallic minerals except fuels | do | $62 | $60 | $69 |
| Oil and gas extraction | do | $162 | $131 | $142 |
| Manufacturing total | do | $26,450 | $28,485 | $33,107 |
| Primary metal industries | do | $1,748 | $1,763 | $1,929 |
| Stone, clay, and glass products | do | $423 | $454 | $523 |
| Chemicals and allied products | do | $1,274 | $1,332 | $1,436 |
| Petroleum and coal products | do | $97 | $97 | $100 |
| Construction | do | $2,467 | $2,549 | $2,640 |
| Transportation and public utilities | do | $4,189 | $4,424 | $4,643 |
| Wholesale and retail trade | do | $9,863 | $10,410 | $11,643 |

See footnotes at end of table.

**Table 3.—Indicators of Michigan business activity —Continued**

| | 1982^r | 1983 | 1984^p |
|---|---|---|---|
| Earnings by industry —Continued | | | |
| Finance, insurance, real estate millions | $2,813 | $3,090 | $3,315 |
| Services do | $11,948 | $13,166 | $14,447 |
| Government and government enterprises do | $10,262 | $10,755 | $11,286 |
| Construction activity: | | | |
| Number of private and public residential units authorized | 14,276 | 21,638 | 26,474 |
| Value of nonresidential construction millions | $1,091.5 | $1,193.3 | $1,651.8 |
| Value of State road contract awards do | $186.4 | $281.6 | $221.5 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,371 | 1,527 | 1,993 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $1,035.2 | $1,178.9 | $1,408.6 |
| Value per capita | $114 | $130 | $155 |

^p Preliminary. ^r Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

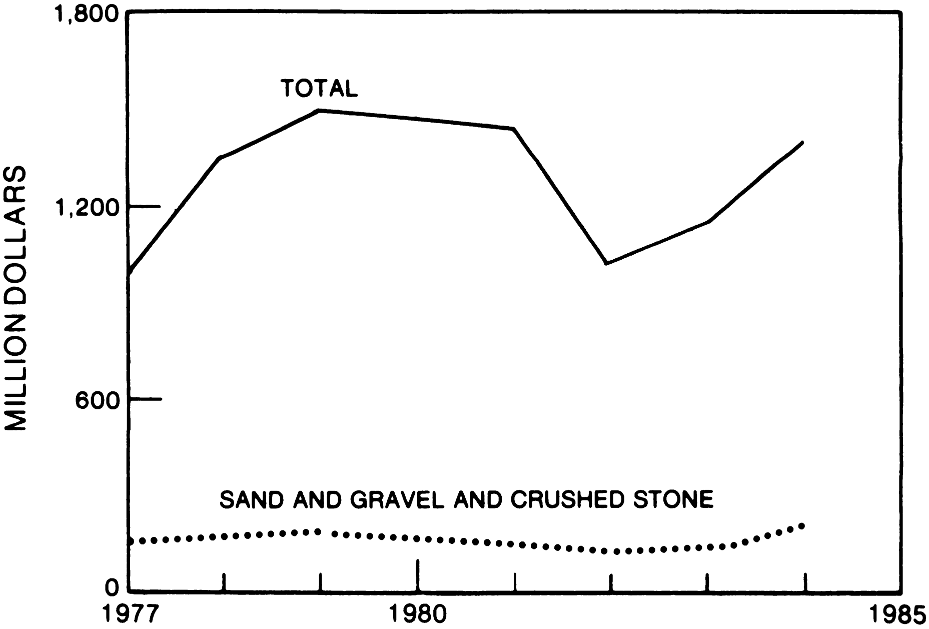

Figure 1.—Value of construction sand and gravel and crushed stone and total value of nonfuel mineral production in Michigan.

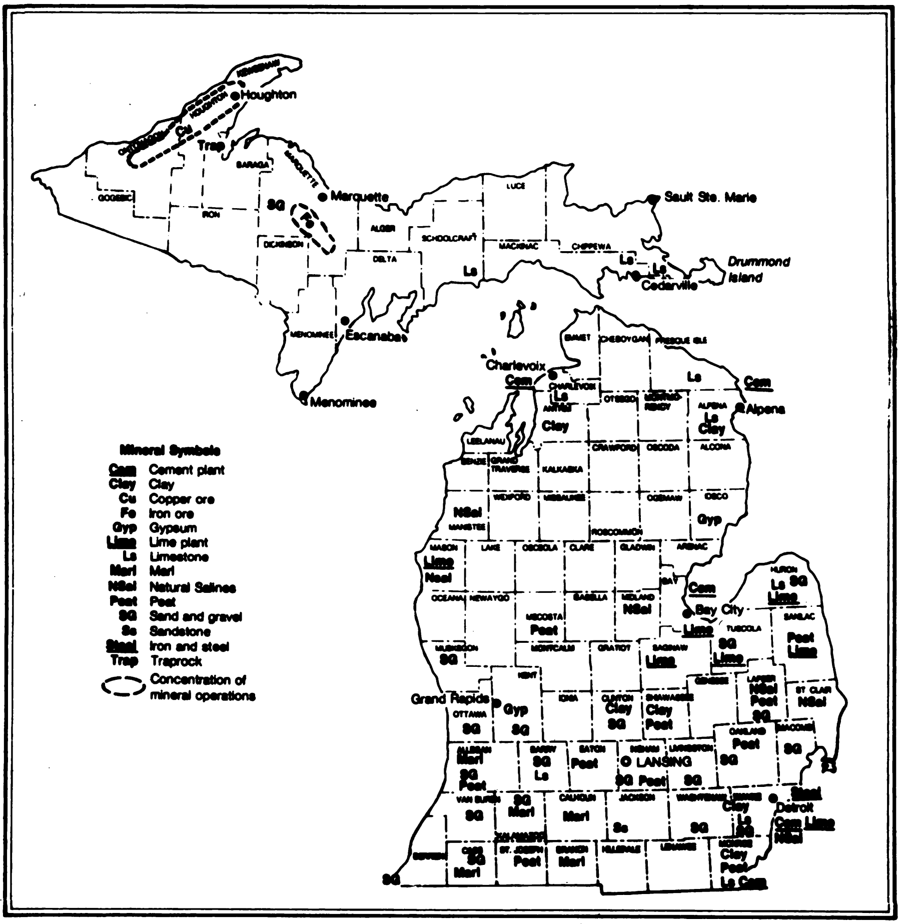

Figure 2.—Principal mineral producing localities in Michigan.

duced in the State, with declines reported for iodine, magnesium compounds, industrial sand, and dimension stone.

**Trends and Developments.**—Several developments occurred within the State's mineral industry. Two companies agreed to sell their subsidiaries during 1984. Gifford-Hill & Co. Inc. agreed to sell Peerless Cement Co., a wholly owned subsidiary based in Detroit, to St. Mary's Cement Ltd., headquartered in Toronto, Ontario, Canada. The Louisiana Land and Exploration Co. agreed to sell its Copper Range Co. to Echo Bay Mines Ltd. based in Edmonton, Alberta, Canada. The sales agreement included the White Pine Copper Co. complex in the Upper Peninsula.

Callahan Mining Corp.'s board of directors approved the expenditure of $11.3 million to bring the Ropes gold mine into production. The funds were to be used for mine development and purchase of an ore processing plant.

Domtar Industries Inc. of Montreal, Quebec, Canada, refurbished the gypsum mine and wallboard plant near Grand Rapids that it had purchased from Grand Rapids Gypsum Co. in 1981. Idle since 1980, the mine and plant resumed production in February.

PPG Industries Inc., Pittsburgh, PA, began construction of a test facility for solution mining potash in Grant Township, Mecosta County. The company had been exploring in the area since 1976.

Two companies announced plans during 1984 to end their brine operations. Morton Thiokol Inc. closed its Marysville salt plant in St. Clair County on December 31 after almost 85 years of operation. The Dow Chemical Co. was to phase out its brine products business in Midland over a 2-year period. Dow Chemical began producing brine products in Midland in 1890 with the extraction of bromine.

In the State's steel industry, Rouge Steel Co., Ford Motor Co.'s subsidiary, awarded a $130 million contract for a continuous slab casting plant. The firm also announced that it would jointly construct and operate a $130 million galvanizing plant with the United States Steel Corp. National Steel Corp. began work on a new $70 million galvanizing line and was to invest $20 million to modernize the Ecorse mill's steel processing and finishing operations.

**Employment.**—Michigan's economy continued to expand. Michigan Employment Security Commission statistics showed that the State's unemployment rate dropped from 14.2% in 1983 to 11.2% in 1984, and the rate in the 15-county Upper Peninsula area dropped from 17.5% to 14.9%. Mining employment in the Upper Peninsula averaged about 3,000 persons during 1984 compared with approximately 2,600 persons in 1983. The entire State averaged about 9,400 persons employed in mining during 1984.

The Michigan Department of Labor reported three mineral industry strikes over contract renewals during 1984. Workers at the White Pine Copper complex in the Upper Peninsula went on strike on August 1, 1983, and remained on strike throughout 1984. About 130 workers represented by the United Steelworkers of America were employed at the mine at that time. The rest were on a layoff status.

Thirty-five workers represented by the General Teamsters Union struck Nugent Sand Co. Inc. of Muskegon on May 5, 1984. The strike was not resolved by yearend. Management personnel and some newly hired employees continued company operations.

Workers at Dundee Cement Co. at Dundee, represented by the United Cement, Lime, Gypsum & Allied Workers Union, went on strike on June 20, 1984. The strike, affecting 170 workers, was resolved on October 10, 1984.

**Exploration Activities.**—Michigan held its second metallic mineral lease sale in May, at which mineral rights were offered for lease on 50,230.54 acres of State-owned mineral lands in eight counties in the Upper Peninsula. The State received bonus bids totaling $112,087.84 for mineral lease rights on 23,734.08 acres in Dickinson, Gogebic, Iron, and Marquette Counties. The highest bid was $26 per acre for a 280-acre tract in Mansfield Township of Iron County that reportedly had potential for diamonds. The average bid was $4.76 per acre, $1 more per acre than the average bid in the State's first lease sale held in 1983.

Six companies were reported to have active exploration programs during 1984. Eighty-three test holes, totaling 15,007 feet, were drilled on private and State lands. This does not include holes drilled near the Ropes gold mine that was under development. Several of the companies were exploring for diamonds, although there were no public announcements of discoveries.

In another area of the Upper Peninsula, several companies applied for oil and gas leases in the Ottawa National Forest. Reportedly, about 129,000 acres was applied for by July, mostly in southern Ontonagon County. This oil play is related to the midcontinent rift system and a similar play in Wisconsin.

In south-central Michigan, PPG Industries continued exploring for potash through its subsidiary, Willmet Corp. Reportedly, 10 holes were drilled in 1984.

**Shipping.**—The 1984 commercial navigation season began on March 25 with the opening of the American locks at Sault Ste. Marie and ended on January 5, 1985. The late closing date for the locks was caused by a jammed vertical lift at a St. Lawrence River bridge that shut down the seaway for about 2 weeks and the need to clear the seaway of ships before ice conditions set in. The Corps of Engineers reported that traffic through the locks totaled 82.4 million short tons in 1984, compared with 78.6 million tons in 1983. Mineral commodities accounted for the greatest percentage of the tonnage. A statistical summary of mineral products shipped through the locks in 1983 and 1984 is given in table 4.

During the 1984 shipping season, the Lake Carriers Association reported 57.2 million long tons of United States and Canadian iron ore was moved across the Great Lakes. This was a 12% increase over the 51.2 million tons reported in 1983. Most Canadian ore traveled the St. Lawrence Seaway to southern Great Lakes ports without passing through the locks at Sault Ste. Marie. Total U.S. iron ore shipped in 1984 was 45.9 million tons compared with 41.0 million tons shipped in 1983.

Michigan's iron ore is shipped through Lake Superior & Ishpeming Railroad's

Presque Isle terminal at Marquette and Chicago & Northwestern Transportation Co.'s terminal at Escanaba. The Presque Isle terminal shipping season began on May 2 and ended on December 27. Iron ore shipped through the terminal totaled 4.5 million long tons in 1984, compared with 3.5 million tons shipped in 1983.

The terminal at Escanaba opened on March 8, and the final shipment in 1984 was on December 24. About 8.7 million long tons was shipped through the terminal in 1984 compared with 7.4 million tons shipped in 1983.

During 1984, Cleveland-Cliffs Steamship Co. announced that it planned to sell two lake vessels to Rouge Steel. The lake carriers are self-unloaders and will upgrade Rouge Steel's iron ore shipping capability.

**Table 4.—Michigan: Mineral products shipped through the Sault Ste. Marie locks**

(Short tons)

| Commodity | 1983 | 1984 |
|---|---|---|
| Cement | 440,572 | 467,512 |
| Coal | 9,867,111 | 11,446,950 |
| Iron ore | [r]37,131,253 | 40,763,507 |
| Iron and steel (manufactured), pig iron | 284,356 | 226,877 |
| Potash | 1,614,064 | 2,054,257 |
| Salt | 339,981 | 311,980 |
| Scrap (ferrous) | 22,356 | 76,395 |
| Stone[1] | 1,708,718 | 1,902,828 |
| Total | [r]51,408,411 | 57,250,306 |

[r] Revised.

[1] Includes broken stone, gravel, and sand.

Source: Corps of Engineers, Detroit District.

**Legislation and Government Programs.**—Several mining-related bills were enacted during 1984. Public Act 116 eliminated timbering and general underground work experience as requirements for a county mine inspector post. Mine inspectors also were required to visit all mines in the county once every 60 days.

Public Act 204 provided for an inventory of State-owned peat lands, authorized the Michigan Department of Natural Resources to contract for the taking of peat from State-owned lands, and provided for the disposition of royalties and proceeds accrued from peat lands.

Public Act 337 amended the State's "Sand Dune Protection and Management Act of 1976" by increasing fees and bonding requirements of sand dune mining operations. Fees were increased from 1 cent to 10 cents per short ton of sand mined to fund the State's surveillance, administration, and enforcement of the Sand Dune Protection and Management Act. Bonding requirements were increased fivefold.

The Michigan Geological Survey Division continued to provide information on the State's geology and mineral resources to State and local officials and the public. The Survey staff completed a draft of a new State bedrock geology map that was in the process of being digitized. Several staff members worked on a land exchange with the U.S. Forest Service. The exchange, to consolidate State and Federal surface and mineral ownership, involved 14,305 acres in 13 counties.

The State received $1,213,250 from the Federal Government in fiscal year 1984 as its share of funds generated by activities on national forest lands (timbering, mineral leasing, recreation, user fees, etc.). This compared with $943,500 the State received in fiscal year 1983. Michigan also received $1,275,610 from the Federal Government as "payments in lieu of taxes" that go to local governments for Federal tax-exempt lands in the State.

In fiscal year 1984, the U.S. Bureau of Mines expended $482,207 for active contracts and grants with industrial firms, educational institutions, and consulting firms in Michigan. Of these funds, over $392,000 was awarded to Michigan Technological University to investigate the effectiveness of diesel emission controls for underground metal mines.

The Mining and Mineral Resources and Research Institute at Michigan Technological University, created under title III of Public Law 95-87, received $150,000 for operations and research from the U.S. Bureau of Mines in fiscal year 1984.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Bromine.**—Michigan was one of two States producing bromine. Bromine was extracted from well brines in Mason and Midland Counties by Dow Chemical and in Manistee County by Morton Thiokol. Production and value were estimated to have been the same as in 1983. Bromine was used in manufacturing agricultural chemicals, fire retardants, well-drilling and completion fluids, antiknock gasoline additives, and other chemicals.

In October, Dow Chemical announced plans to phase out its brine products operations at Midland in the next 2 years and to consolidate brine production at its Ludington, MI, and Magnolia, AR, facilities that are more competitive. The closing would affect the jobs of about 200 people who would be reemployed elsewhere in the company. At the same time, the company said it would construct two new specialty chemical manufacturing plants in the Midland area. The new plants, to cost about $25 million when completed in mid-1986, will make polymers used in products such as hot tubs, satellite dishes, etc., and extrusion and injection-molding grades of resins to be used in products such as refrigerator doors and telephones.

**Calcium Chloride.**—Michigan and California were the only two States reporting production of natural calcium chloride in 1984, with Michigan accounting for the greater share of the output. Dow Chemical produced calcium chloride from brine wells in Midland County, and Wilkinson Chemical Corp. produced from brine wells in Lapeer County. Production and value were estimated to have increased over the 1983 output. Dow Chemical announced that it would move its calcium chloride operations to Ludington when it phases out its brine well operations in Midland within the next 2 years.

**Cement.**—Michigan continued to rank fourth nationally in the production of portland cement and seventh in the production of masonry cement. Sales of portland cement increased 22% during 1984, and masonry cement sales climbed 27%. The value per short ton of masonry cement increased by approximately 15%, whereas the value per ton of portland cement remained about equal to the 1983 average.

Portland and masonry cement was produced by 5 companies at 5 manufacturing plants with a total of 13 kilns and at 2 grinding plants. All of the plants produced Types I and II, general use and moderate heat, which accounted for 95% of the portland cement output. Other types produced by one or more of the plants included Type III, high-early-strength; Type V, high-sulfate-resisting; portland-pozzolan and/or portland blast-furnace slag; and a waterproof portland. More than 7 million tons of raw materials was consumed in the cement manufacturing process.

In order of importance, major sales of portland cement were shipped to ready-mixed concrete companies, concrete product manufacturers, highway contractors, and building material dealers. Most cement was shipped to consumers in bulk form by truck.

In August, Gifford-Hill sold its Peerless Cement subsidiary, based in Detroit, to St. Mary's Cement of Toronto, Ontario, Canada, for about $20 million. The company will be called St. Mary's Peerless Cement Co.

Workers at Dundee Cement went on strike on June 20 over a contract dispute that was resolved on October 10. During 1984, Dundee Cement established the Hans Gygi Foundation as a memorial to the company's founder. The foundation will provide college scholarships for the children of employees of Dundee Cement and its wholly owned subsidiaries. The first scholarships were initiated in the fall of 1984.

Medusa Cement Co. completed installation of a kiln-monitoring device to improve fuel use at its Charlevoix plant. The firm shipped its first 1984 boatload of cement to Milwaukee on the *Medusa Challenger* on March 30.

**Clays.**—Michigan ranked eighth nationally in production of common clay and shale, dropping from the seventh place ranking it held in 1983. Production increased about 10% in 1984 although value dropped 11%. Six companies produced clay in five counties. Alpena and Monroe Counties accounted for most of the State's production. Cement manufacture consumed most of the State's clay and shale output. Other uses were for manufacturing drain tile, face brick, flue linings, pottery, and sewer pipe.

**Gem Stones.**—Estimated value of mineral specimens and semiprecious gem stones that dealers and rockhounds collected was $15,000 in 1984. Agates, native copper, and petoskey stones (a fossil coral) were the most common specimens collected. Diamond exploration activities continued throughout 1984 with as many as five companies conducting exploration programs. None of the companies involved has made announcements of discoveries.

**Gypsum.**—Michigan ranked third nationally in the production of crude gypsum, the highest ranking attained since 1979 when the State led the Nation. Production increased about 40% and value increased 27% because of the increased demand generated by the construction industry.

Gypsum was produced from underground mines in Kent County operated by Georgia-Pacific Corp. and Domtar Industries and from open pit mines in Iosco County operated by Michigan Gypsum Co., National Gypsum Co., and United States Gypsum Co. With the exception of Michigan Gypsum, companies calcined most of their output at associated plants. U.S. Gypsum shipped crude ore by water to its plant at Detroit in Wayne County.

U.S. Gypsum's Alabaster Mine and National Gypsum's Tawas Mine, both in Iosco County, ranked third and seventh, respectively, in output in the United States during 1984.

Gypsum was used mainly in wallboard manufacture. Smaller quantities were used for agricultural purposes, building plaster, and cement manufacture.

Upon completion of a $3.8 million refurbishing program, Domtar Industries began production in February at the Kent County mine and wallboard plant that it acquired from Grand Rapids Gypsum in 1981.

**Iodine.**—Dow Chemical continued to extract iodine from well brine solutions at its Midland plant. Production and value were estimated to have declined in 1984. Iodine was used in animal feed additives, catalysts, disinfectants, inks and colorants, pharmaceuticals, and stabilizers.

**Iron Oxide Pigments.**—Michigan ranked first of four States in shipments of crude iron oxide pigments. All shipments originated from stockpiles at Cleveland-Cliffs Iron Co.'s Mather Mine in Marquette County. Shipments increased 44% during 1984.

Finished iron oxide pigments for use in paint and other coatings were produced by BASF Wyandotte Corp. at its plant in Wayne County.

**Lime.**—Nationally, the State ranked ninth in the production of lime. Output increased about 24% during 1984 and average value per short ton increased $2.43. Production occurred in seven counties at eight plants. Wayne County led the State's production. All companies produced quicklime; one company, Marblehead Lime Co. in Wayne County, also produced hydrated lime. Michigan ranked fourth in total lime consumption. Lime consumed in 1984 from all domestic sources totaled 1,197,000 tons.

Lime was used principally in steelmaking, alkalies, water treatment, and sugar refining.

**Magnesium Compounds.**—Michigan led the Nation in production of magnesium compounds. Dow Chemical had well brine operations in Mason and Midland Counties; Martin Marietta Corp., Magnesia Specialties Div., and Morton Thiokol each had a well brine operation in Manistee County. Production and value were estimated to have been approximately the same as in 1983. Magnesium compounds were used mainly in producing high-temperature, basic refractories. Other uses were in animal feeds, construction materials, electrical heating rods, fertilizers, fluxes, petroleum additives, and rayon.

Dow Chemical announced that it would relocate its magnesium hydroxide operation to its Ludington plant when it phases out its brine operations in Midland over the next 2 years.

**Peat.**—Of the 22 States producing peat, Michigan ranked second in production, dropping below Florida's output after having led the Nation in 1983. Production increased about 6%, but average value per short ton dropped 4%. Production was by 13 companies from 10 counties. Sanilac County was the principal producer, followed by Lapeer, Shiawassee, and Oakland Counties. Collectively, these counties accounted for 87% of the State's output.

Reed-sedge was the most common type of peat mined, followed by humus and sphagnum moss. Most of the peat shipped was in packaged form. The greatest quantity of peat was used for general soil improvement, mushroom beds, and in nurseries.

**Perlite (Expanded).**—Two companies expanded crude perlite mined in Western States. Harborlite Corp. had an operation at Vicksburg in Kalamazoo County, and U.S. Gypsum operated a plant at River Rouge in Wayne County. Production and average value per short ton dropped during 1984. Expanded perlite was used as a filler, as a filter aid, and for plaster aggregate.

**Salt.**—Michigan ranked sixth of 16 States in the production of salt. Sales increased 10% during 1984, but average value per short ton dropped $5.90. Salt was produced at brine well operations of five companies operating in three counties. Wayne County, which had shipments from three operations, led the State's production. International Salt Co. shipped some stockpiled salt from its Detroit Mine that was closed in January 1983. Salt was used in food and chemical processing, for ice control, and as table salt.

Morton Thiokol officially closed its Marysville salt plant on December 31, citing high fuel costs, the age of the plant, and a decline in table salt usage.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Nationally, Michigan ranked third in the production of sand and gravel for construction purposes. Output increased nearly 57% over 1983 estimates because of the surge in construction activity during 1984. Mining of sand and gravel occurred in 74 of the State's 83 counties at 447 pits. Oakland County led the State in production, followed by Washtenaw, Ottawa, and Livingston Counties. Collectively, these counties accounted for 38% of the State total. The greatest amount of the sand and gravel was used as road base material and coverings. Most of the output was hauled to the point of end use by truck.

**Table 5.—Michigan: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 6,417 | $20,548 | $3.20 |
| Plaster and gunite sands | 172 | 463 | 2.70 |
| Concrete products | 334 | 809 | 2.42 |
| Asphaltic concrete | 4,801 | 8,589 | 1.79 |
| Road base and coverings[1] | 11,940 | 26,122 | 2.19 |
| Fill | 1,362 | 2,261 | 1.66 |
| Snow and ice control | 368 | 540 | 1.47 |
| Railroad ballast | 32 | 109 | 3.39 |
| Other[2] | 10,646 | 17,099 | 1.60 |
| Total or average | [3]36,071 | 76,540 | 2.12 |

[1] Includes road and other stabilization (cement).
[2] Includes roofing granules and other unspecified uses.
[3] Data do not add to total shown because of independent rounding.

**Table 6.—Michigan: Construction sand and gravel sold or used by producers, by county[1]**

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Alcona | -- | 42 | $83 | -- | -- | -- |
| Alger | 1 | 7 | 17 | 10 | 7 | $9 |
| Allegan | 6 | 273 | 608 | 13 | 1,161 | 2,421 |
| Alpena | 10 | 196 | 373 | 11 | 221 | 718 |
| Antrim | 1 | 87 | 206 | 6 | 105 | 207 |
| Arenac | 2 | 17 | 26 | 3 | W | W |
| Baraga | 8 | 141 | 297 | 8 | W | W |
| Barry | 24 | 246 | 485 | 4 | 552 | 868 |
| Benzie | 1 | 60 | 80 | 1 | 60 | 100 |
| Berrien | 4 | W | W | 4 | 380 | 921 |
| Branch | 9 | 234 | 533 | 8 | 267 | 586 |
| Calhoun | 5 | 155 | 511 | 7 | 365 | 511 |
| Cass | 8 | 237 | 378 | 8 | 663 | 987 |
| Charlevoix | 28 | 194 | 578 | 3 | 91 | 158 |
| Cheboygan | 2 | 16 | 29 | 2 | W | W |
| Chippewa | 1 | 178 | 322 | 3 | 143 | 256 |
| Clare | 7 | 172 | 320 | 3 | 184 | 355 |

See footnotes at end of table.

## Table 6.—Michigan: Construction sand and gravel sold or used by producers, by county[1] —Continued

| County | 1982 Number of mines | 1982 Quantity (thousand short tons) | 1982 Value (thousands) | 1984 Number of mines | 1984 Quantity (thousand short tons) | 1984 Value (thousands) |
|---|---|---|---|---|---|---|
| Clinton | 9 | 430 | $1,015 | 7 | 668 | $1,318 |
| Delta | 4 | 115 | 498 | 8 | 390 | 885 |
| Dickinson | 7 | 203 | 425 | 10 | 362 | 792 |
| Eaton | 5 | 156 | 334 | 4 | 121 | 234 |
| Emmet | 11 | W | W | 9 | 165 | 216 |
| Gladwin | 1 | 3 | 4 | -- | -- | -- |
| Gogebic | 23 | 63 | 82 | 21 | 186 | 203 |
| Grand Traverse | 3 | 37 | 53 | 3 | 157 | 161 |
| Gratiot | 4 | 176 | 304 | 4 | 148 | 391 |
| Hillsdale | 5 | 391 | 874 | 4 | 436 | 1,060 |
| Huron | 3 | 167 | 292 | 13 | 597 | 861 |
| Ingham | 2 | W | W | 3 | 629 | 1,744 |
| Ionia | 8 | 47 | 71 | 9 | 167 | 238 |
| Iosco | -- | -- | -- | 1 | 35 | 88 |
| Iron | 3 | 65 | 174 | 3 | 71 | 228 |
| Isabella | 4 | 398 | 985 | 5 | 181 | 349 |
| Jackson | 4 | 110 | 272 | 2 | W | W |
| Kalamazoo | 7 | 687 | 1,827 | 10 | 1,682 | 3,963 |
| Kalkaska | 1 | 7 | 7 | 2 | 19 | 21 |
| Kent | 32 | 1,062 | 2,827 | 23 | 1,504 | 4,527 |
| Keweenaw | 1 | 17 | 44 | 1 | 11 | 23 |
| Lapeer | 10 | 715 | 1,440 | 10 | 1,215 | 2,441 |
| Leelanau | 3 | W | W | 3 | 297 | W |
| Lenawee | 1 | W | W | 3 | 391 | 957 |
| Livingston | 11 | 1,234 | 2,804 | 17 | 1,814 | 4,248 |
| Luce | 1 | 14 | 60 | 1 | 22 | 65 |
| Mackinac | 19 | 121 | 183 | 4 | 214 | 258 |
| Macomb | 5 | 594 | 1,831 | 5 | 914 | 2,720 |
| Manistee | 2 | 40 | 58 | 1 | W | W |
| Marquette | 7 | 206 | 620 | 9 | 543 | 1,409 |
| Mason | 2 | 36 | 41 | 1 | 60 | 60 |
| Mecosta | 2 | W | W | 6 | 292 | 381 |
| Menominee | 2 | 210 | 268 | 2 | W | W |
| Missaukee | 1 | 40 | 51 | 3 | 230 | 262 |
| Montcalm | 2 | 69 | 142 | 4 | 257 | 394 |
| Muskegon | 1 | 14 | W | 6 | 459 | 913 |
| Oakland | 22 | 5,271 | 13,418 | 27 | 7,818 | 16,901 |
| Oceana | 4 | 134 | 307 | 4 | 93 | 249 |
| Ogemaw | 2 | 385 | 853 | 3 | 319 | 673 |
| Ontonagon | 10 | 135 | 156 | 13 | 343 | 574 |
| Oscoda | -- | -- | -- | 1 | 159 | 159 |
| Otsego | 11 | 47 | 80 | 2 | W | W |
| Ottawa | 11 | 538 | 1,361 | 9 | 1,874 | 3,792 |
| Presque Isle | 3 | 281 | 617 | 4 | 411 | 891 |
| Roscommon | 1 | 11 | 12 | 1 | 11 | 17 |
| Saginaw | 2 | 19 | 19 | -- | -- | -- |
| St. Joseph | 2 | W | W | 3 | 256 | 466 |
| Sanilac | 1 | W | W | 3 | 187 | 343 |
| Schoolcraft | -- | -- | -- | 5 | 127 | 200 |
| Tuscola | 15 | 522 | 991 | 16 | 836 | 1,305 |
| Van Buren | 3 | 245 | 447 | 2 | W | W |
| Washtenaw | 14 | 1,269 | 2,175 | 18 | 2,286 | 4,345 |
| Wayne | 2 | 350 | 1,266 | 3 | 1,041 | 1,522 |
| Wexford | 2 | 54 | 65 | 3 | 163 | 330 |
| Undistributed[2] | 9 | 1,621 | 3,526 | 19 | 1,713 | 5,265 |
| Total[3] | 437 | 20,567 | 47,726 | 447 | 36,071 | 76,540 |

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Bay, Crawford, Midland, Monroe, and Montmorency Counties are not listed because no production was reported.

[2] Includes Genesee (1982), Houghton, Lake, Newaygo, Osceola, St. Clair, and Shiawassee Counties and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—Michigan ranked second nationally in industrial sand output, trailing Illinois by about 700,000 short tons. Production decreased 4% during 1984, although value increased about 20%. Some of the decline in production could be attributed to the environmental obstacles facing industrial sand operators mining in environmentally sensitive sand dune areas. Industrial sand was mined by 9 companies at 13 operations in 9 counties. Ottawa and Berrien Counties, respectively, led the State's production, accounting for 44% of the total. Major sales of Michigan industrial sand were for foundry applications. Most of the State's industrial sand was shipped by truck to the point of end use.

A 6-year battle over sand dune mining in southwestern Michigan ended with a settlement that could protect most of the ecologically sensitive Bridgman Dunes. Under an agreement with the Natural Resources

Commission (NRC) and a circuit court judge, dune owner Unimin Corp. was allowed to mine 44.8 acres at the site. However, the State would have an option to purchase 210 acres, appraised at $1.9 million to $2.7 million, to add to the Warren Dunes State Park. Martin Marietta applied for a mining permit in 1978, asking to mine 144 acres. In 1981, NRC issued that permit, but the State attorney general and environmental groups filed suit trying to prevent the mining of the sand. Martin Marietta later sold the property to Unimin, a New Canaan, CT, firm.

Under the agreement, Unimin can mine for 10 years an area in the southeastern corner of the property, farthest from the Lake Michigan shoreline. The State has until November 1985 to purchase the 210 additional acres. If the State fails to make the purchase, the question of mining on that land reverts back to the circuit court judge.

Construction Aggregates Corp. received a permit under the city of Ferryburg's new sand mining ordinance. The firm had been operating under a State permit issued in 1982. The city permit required more gradual slopes around the pit and additional buffer areas. Construction Aggregates would also pay a utility development fee of $5,000 annually that would be placed in a special account until the principal and interest totaled $100,000. When mining is terminated, the funds would be used to extend sewer, water, and other services to the site on which a 140-acre lake would be created.

**Slag—Iron and Steel.**—Michigan ranked fourth in sales of processed iron and steel slag. Edward C. Levy Co. continued to process slag in Wayne County from the steel mills of McLouth Steel Products Corp., the Great Lakes Steel Div. of National Steel, and Rouge Steel. Sales increased about 500,000 short tons during 1984 because of the upsurge in construction activity. Processed slag was used for asphaltic concrete aggregate, fill, railroad ballast, and road base material.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Crushed stone production was estimated to have increased 13% during 1984, with the value increasing about 12%. Historically, the State's crushed stone output has been used mainly for cement manufacture, lime manufacture, and as flux stone for steel mills. Demand in these areas, along with gains in highway construction, accounted for the modest increase in crushed stone production.

*Dimension.*—Production was estimated to have dropped slightly during 1984, but value increased 15%. Napoleon Sandstone Quarry closed on December 31, leaving only one dimension sandstone producer in the State.

**Sulfur (Recovered).**—Byproduct sulfur was recovered at the petroleum refining operations of Marathon Oil Co. in Wayne County, Shell Western E&P Inc. in Manistee County, and Total Petroleum Inc. in Gratiot County. Most was used in manufacturing sulfuric acid. Sales increased 3% over 1983 figures, and the value increased an average of $2.44 per metric ton.

**Vermiculite (Exfoliated).**—Crude vermiculite shipped in from other States was exfoliated at the W. R. Grace & Co. plant in Dearborn, Wayne County. Sales increased about 31% during 1984. Major uses were for block and loose-fill insulation and fireproofing. Other uses were for concrete and plaster aggregates and agricultural purposes.

## METALS

**Abrasives (Manufactured).**—Michigan ranked second of the four States producing metallic abrasives during 1984. Three companies produced steel shot and grit. Abrasive Materials Inc. had operations at Hillsdale in Hillsdale County, Ervin Industries Inc. at Adrian in Lenawee County, and Metaltec Steel Abrasives Co. at Canton in Wayne County. Abrasive Materials also produced cut wire shot. Sales of manufactured abrasives increased about 59% as the State's economy rebounded. Manufactured abrasives were used primarily by the automotive, foundry, and steel industries.

**Copper and Silver.**—Michigan had no copper or silver production during 1984, although some copper concentrates and copper scrap were processed at White Pine Copper's new electrolytic copper refinery at White Pine. The refinery was operated by management and salaried personnel as union workers were on strike since August 1983. Late in 1984, Louisiana Land and Exploration agreed to sell its Copper Range company, of which White Pine Copper is a division, to Echo Bay Mines, based in Edmonton, Alberta, Canada. The transaction was expected to be completed in early 1985. No plans were announced for reopening the mine complex or the new electrolytic refinery that was shut down on September 7.

**Gold.**—Callahan Mining continued mine development at its Ropes gold property near Ishpeming in the Upper Peninsula. The 7,000-foot-plus spiral decline to the ore body was completed near yearend, and development drifting was accomplished on several levels. Callahan Mining purchased the inactive Humboldt Mining Co. iron ore flotation mill, situated about 16 miles from the mine, from Cleveland-Cliffs Iron and Rouge Steel and commenced refurbishment and construction of the mill, which was to be designed to process 2,000 short tons of ore per day from the Ropes gold mine. The mill was expected to be processing ore by August 1985.

**Iron Ore.**—Michigan ranked second, behind Minnesota, in iron ore shipments in 1984. Shipments increased about 24% over those reported in 1983 as the steel industry continued a modest recovery. All shipments were by Cleveland-Cliffs Iron from its Marquette Range properties. The Empire and Tilden Mines were the only active mining operations in 1984, with average operating rates of 90% and 72% of capacity, respectively. The Republic Mine, owned entirely by Cleveland-Cliffs Iron, remained idle throughout the year. Production of pellets totaled 12.9 million long tons with the Empire Mine producing 7.2 million tons; the Tilden Mine produced the remainder. At the Tilden, only one pelletizing line was in operation for most of the year, and operations were shut down between July 21 and August 13.

Cleveland-Cliffs Iron continued restructuring its iron mining partnerships with a 10% interest in the Empire Iron Mining partnership being acquired by McLouth Steel Products of Trenton, MI. This action reduced Cleveland-Cliffs Iron's interest in the partnership to 5%.

At yearend, about 1,100 production and maintenance employees of Cleveland-Cliffs Iron remained on layoff status. Salaried employees were also affected by layoffs or reduced work schedules.

At the end of the 1984 shipping season, Cleveland-Cliffs Iron sold two of its largest Great Lakes ore carriers, the SS *Walter A. Sterling* and the SS *Edward B. Greene*, to Rouge Steel.

In October, The Hanna Mining Co. auctioned off its equipment at the Groveland Mine near Iron Mountain. This marked the official closing of the mine, which had been in existence since 1959. The Groveland Mine was idled in January 1981.

**Table 7.—Michigan: Usable iron ore[1] produced (direct shipping and all forms of concentrates), by range**

(Thousand long tons, gross weight, unless otherwise specified)

| Year | Marquette Range | Menominee Range (Michigan part) | Gogebic Range (Michigan part) | Total | | |
|---|---|---|---|---|---|---|
| | | | | Gross weight | | Iron content (percent) |
| | | | | Ore | Iron content | |
| 1854-1979 | 493,156 | 314,187 | 249,625 | 1,056,968 | NA | NA |
| 1980 | 14,450 | 1,970 | -- | 16,420 | 10,482 | 63.8 |
| 1981 | 15,508 | 75 | -- | 15,583 | 10,020 | 64.3 |
| 1982 | 6,874 | -- | -- | 6,874 | 4,426 | 64.4 |
| 1983 | 9,339 | -- | -- | 9,339 | 6,024 | 64.5 |
| 1984 | 12,982 | -- | -- | 12,982 | 8,374 | 64.5 |
| Total | 552,309 | [2]316,232 | [2]249,625 | 1,118,166 | NA | NA |

NA Not available.

[1] Exclusive after 1905 of iron ore containing 5% or more manganese.

[2] Distribution by range partly estimated before 1906.

**Iron and Steel.**—Michigan ranked fourth nationally in shipments of pig iron. Shipments climbed to 5.1 million short tons in 1984 compared with 4.4 million tons in 1983. Although showing a modest improvement in 1984, most mills operated below capacity.

During 1984, McLouth Steel Products received a $4 million Urban Development Action Grant through the municipality of Wyandotte to apply toward a $25 million project to replace electric induction reheating furnaces with gas-fired furnaces. The new furnaces were expected to be in operation in the fourth quarter of 1985.

Ford Motor and U.S. Steel announced that they would jointly construct and operate a $130 million galvanizing plant at Ford Motor's Rouge Works south of Detroit. The plant was scheduled to begin operation in mid-1986, in time for the 1987 model year. The agreement called for a 50-50 commitment of money and material with both companies supplying steel for galvanizing.

Rouge Steel also awarded a $130 million contract for a continuous slab casting plant that was expected to be operating in the spring of 1986. The plant was to have an annual capacity of 1.8 million tons and to cut production costs considerably.

National Steel's Great Lakes Div. invested $20 million to modernize its steel processing and finishing operations and $70 million on a new galvanizing line to make rust-resistant steel for the automotive industry, its biggest customer.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN.

[2] Editorial assistant, Bureau of Mines, Minneapolis, MN.

**Table 8.—Principal producers**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Aetna Cement Corp., a subsidiary of Lake Ontario Cement Ltd. | Box 80<br>Essexville, MI 48732 | Grinding plant | Bay. |
| Dundee Cement Co., a division of Holderbank Financiere Glaris SA.[1] [2] | Box 122<br>Dundee, MI 48131 | Quarry, clay pit, plant | Monroe. |
| Medusa Cement Co., Medusa Corp., a subsidiary of Crane Co.[1] [2] | Box 5668<br>Cleveland, OH 44101 | Quarry and plant<br>Clay pit | Charlevoix.<br>Antrim. |
| National Gypsum Co., Huron Cement Div.[1] [2] | 4000 Town Center<br>Suite 2000<br>Southfield, MI 48075 | Quarry, clay pit, plant | Alpena. |
| St. Mary's Cement Ltd.: | 22 Yonge St.<br>Toronto, Ontario M4S 2C6, Canada | | |
| St. Mary's Peerless Cement Co | | Plant | Wayne. |
| Wyandotte Cement Inc | | Grinding plant | Do. |
| Clays: | | | |
| F. W. Ritter Sons Co | 12670 North Dixie Hwy.<br>South Rockwood, MI 48179 | Clay pit and plant | Monroe. |
| Charles J. Rogers Inc | Box 3080<br>Melvindale, MI 48122 | Clay pit | Wayne. |
| U.S. Brick Co., Michigan Div., a subsidiary of Canada Brick Co. | 3820 Serr Rd.<br>Corunna, MI 48817 | Clay pit and plant | Shiawassee. |
| Gypsum: | | | |
| Domtar Industries Inc | Box 1670<br>Grand Rapids, MI 49501 | Underground mine and plant. | Kent. |
| Georgia-Pacific Corp | 133 Peachtree St., NE.<br>Atlanta, GA 30303 | do | Do. |
| Michigan Gypsum Co | Box 6280<br>Saginaw, MI 48608 | Open pit mine | Iosco. |
| National Gypsum Co | 2001 Rexford Rd.<br>Charlotte, NC 28211 | Open pit mine and plant. | Do. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | Open pit mine<br>Plant | Do.<br>Wayne. |
| Iron ore: | | | |
| Cleveland-Cliffs Iron Co.[3] | 504 Spruce St.<br>Ishpeming, MI 49849 | Open pit mines and plants. | Marquette. |
| Iron and steel: | | | |
| McLouth Steel Products Corp | 300 South Livernois Ave.<br>Detroit, MI 48217 | Plant | Wayne. |
| National Steel Corp., Great Lakes Steel Div. | Tecumseh Rd.<br>Ecorse, MI 48229 | do | Do. |
| Rouge Steel Co., a subsidiary of Ford Motor Co. | 3001 Miller Rd.<br>Dearborn, MI 48121 | do | Do. |
| Lime: | | | |
| Detroit Lime Co., a subsidiary of Edward C. Levy Co. | 9300 Dix Ave.<br>Dearborn, MI 48120 | do | Do. |
| The Dow Chemical Co., Ludington Div | 2020 Dow Center<br>Midland, MI 48640 | do | Mason. |
| Marblehead Lime Co., a division of General Dynamics Corp. | 300 West Washington St.<br>Chicago, IL 60606 | Plants | Wayne. |

See footnotes at end of table.

## Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Lime —Continued | | | |
| Michigan Sugar Co | Box 1348<br>Saginaw, MI 48605 | Plants | Huron, Saginaw, Sanilac, Tuscola. |
| Peat: | | | |
| Al-Par Peat Co | 9551 Krouse<br>Ovid, MI 48866 | Bog and plant | Shiawassee. |
| Fletcher & Rickard | 25800 Haas Rd.<br>New Hudson, MI 48165 | do | Oakland. |
| Hyponex Corp | 2013 South Anthony Blvd.<br>Fort Wayne, IN 46803 | Bogs and plants | Lapeer and Shiawassee. |
| Michigan Peat Co | Box 66388<br>Houston, TX 77266 | do | Sanilac. |
| Perlite (expanded): | | | |
| Harborlite Corp | Box 458<br>Escondido, CA 92025 | Plant | Kalamazoo. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | Open pit mine<br>Plant | Do.<br>Wayne. |
| Salines (natural):[4] | | | |
| The Dow Chemical Co | 2020 Dow Center<br>Midland, MI 48640 | Brine wells and plants | Mason and Midland. |
| Martin Marietta Corp., Magnesia Specialties Div. | Executive Plaza II<br>Hunt Valley, MD 21030 | Brine wells and plant | Manistee. |
| Morton Thiokol Inc | 110 North Wacker Dr.<br>Chicago, IL 60606 | do | Do. |
| Salt: | | | |
| Diamond Crystal Salt Co | 916 South Riverside<br>St. Clair, MI 48079 | do | St. Clair. |
| Hardy Salt Co | Drawer 449<br>St. Louis, MO 63166 | do | Manistee. |
| Morton Salt Co., a division of Morton Thiokol Inc. | 110 North Wacker Dr.<br>Chicago, IL 60606 | do | Manistee and St. Clair. |
| Sand and gravel: | | | |
| Construction: | | | |
| American Aggregates Corp | Drawer 160<br>Greenville, OH 45331 | Pits and plants | Kalamazoo, Livingston, Macomb, Oakland. |
| Blount Materials Corp | Box 1468<br>Saginaw, MI 48605 | do | Oakland and Osceola. |
| Holloway Sand & Gravel Co. Inc | 29250 Wixom Rd.<br>Wixom, MI 48096 | do | Lapeer, Oakland, Washtenaw. |
| Edward C. Levy Co.: | | | |
| Lyon Sand & Gravel Co | 4780 South Hill<br>New Hudson, MI 48165 | do | Oakland. |
| Milford Sand & Gravel Co | do | do | Do. |
| Bill Smith Sand & Gravel Inc | Box 23<br>Otsego, MI 49078 | do | Allegan, Delta, Huron, Kalamazoo, Tuscola. |
| Whittaker & Gooding Co | 5800 Cherry Hill Rd.<br>Ypsilanti, MI 48197 | do | Lapeer, Oakland, Washtenaw. |
| Yerington Construction Co | 1055 North Shore Dr.<br>Benton Harbor, MI 49022 | do | Barry, Berrien, Cass, Kalamazoo, Van Buren. |
| Industrial: | | | |
| Construction Aggregates Corp | Box 68<br>Ferrysburg, MI 49409 | Pit and plant | Ottawa. |
| Manley Brothers of Indiana Inc | Box 538<br>Chesterton, IN 46304 | Pits and plants | Berrien and Van Buren. |
| Nugent Sand Co. Inc | Box 1209<br>Muskegon, MI 49443 | do | Muskegon. |
| Ottawa Silica Co., Michigan Silica Div. | Box 577<br>Ottawa, IL 61350 | Pit and plant | Wayne. |
| Sand Products Corp | 1938 First National Bldg.<br>Detroit, MI 48226 | do | Oceana. |
| Sargent Sand Co | Box 6280<br>Saginaw, MI 48608 | Pits and plants | Mason, Tuscola, Wexford. |
| Unimin Corp | 258 Elm St.<br>New Canaan, CT 06840 | Pit and plant | Berrien. |
| Slag—iron and steel: | | | |
| Edward C. Levy Co | 8800 Dix Ave.<br>Detroit, MI 48209 | Plants | Wayne. |

See footnotes at end of table.

## Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Stone (1983): | | | |
| Crushed: | | | |
| Limestone: | | | |
| Drummond Dolomite Inc., a division of Bethlehem Steel Corp. | Martin Tower<br>Bethlehem, PA 18016 | Quarry and plant | Chippewa. |
| France Stone Co | Box 1928<br>Toledo, OH 43603 | do | Monroe. |
| Inland Lime & Stone Co., a division of Inland Steel Co. | Gulliver, MI 49840 | Quarries and plants | Mackinac and Schoolcraft. |
| Presque Isle Corp | Box 426<br>Alpena, MI 49707 | Quarry and plant | Presque Isle. |
| Rockwood Stone Inc | Box 113<br>Rockwood, MI 48173 | Quarries and plants | Monroe and Wayne. |
| United States Steel Corp., Michigan Limestone Operations. | Rogers City, MI 49779 | do | Mackinac and Presque Isle. |
| Marl: | | | |
| Poehlman & Son | Route 2<br>Cassopolis, MI 49031 | Pit | Cass. |
| Traprock: | | | |
| Houghton County Road Commission. | Box 269<br>Hancock, MI 49930 | Quarries and plant | Houghton. |
| Dimension: | | | |
| Limestone: | | | |
| Inwood Stone Products Co | Box 24<br>Cooks, MI 49817 | Quarry | Schoolcraft. |
| Onaway Stone Co | 715 Three Mile Rd.<br>Traverse, MI 49684 | do | Presque Isle. |
| Sandstone: | | | |
| Jude Stone Quarry Co | 338 Austin Rd.<br>Napoleon, MI 49261 | do | Jackson. |
| Sulfur (recovered): | | | |
| Marathon Oil Co | 1300 South Fort St.<br>Detroit, MI 48217 | Elemental sulfur recovered as a byproduct of oil refining. | Wayne. |
| Shell Western E&P Inc | Box 1523<br>Houston, TX 77251 | do | Manistee. |
| Total Petroleum Inc | 999 18th St., 23d Floor<br>Denver, CO 80202 | do | Gratiot. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 62 Whittemore Ave.<br>Cambridge, MA 02140 | Processing plant | Wayne. |

[1] Also clays.
[2] Also crushed limestone.
[3] Also crude iron oxide pigments.
[4] Includes bromine, calcium chloride, iodine, and magnesium compounds.

# The Mineral Industry of Minnesota

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Mineral Resources Research Center, University of Minnesota, for collecting information on all nonfuel minerals.**

## By James H. Aase[1]

The value of nonfuel mineral production in Minnesota during 1984 was $1.7 billion, an increase of 15% over that of 1983 and 11% above the 10-year average. The increase over that of 1983 was primarily the result of higher levels of iron ore shipments, supplemented by greater output of several other minerals.

Minnesota ranked third among the States in value of nonfuel mineral production, accounting for 7% of the U.S. total. Seven of the ten minerals produced in the State during 1984 recorded increases in value over those of 1983, and the same number registered production gains. Iron ore accounted for nearly 93 cents of every dollar of the State's total mineral value.

**Table 1.—Nonfuel mineral production in Minnesota[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Gem stones | NA | $5 | NA | $5 |
| Iron ore (usable) thousand long tons, gross weight | 30,699 | 1,342,455 | 35,602 | 1,561,516 |
| Manganiferous ore short tons | 11,314 | W | 68,019 | W |
| Peat thousand short tons | W | W | 24 | W |
| Sand and gravel: | | | | |
| Construction do | $^{e}$24,600 | $^{e}$53,000 | 22,612 | 49,087 |
| Industrial do | 685 | 12,932 | W | W |
| Stone: | | | | |
| Crushed do | 8,580 | 25,320 | $^{e}$8,900 | $^{e}$25,800 |
| Dimension do | 28 | 11,365 | $^{e}$39 | $^{e}$13,369 |
| Combined value of clays, lime, and values indicated by symbol W | XX | 9,953 | XX | 26,470 |
| Total | XX | 1,455,030 | XX | 1,676,247 |

$^{e}$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Minnesota, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Aitkin | $57 | $27 | Peat. |
| Anoka | W | (2) | |
| Becker | 756 | (2) | |
| Beltrami | 193 | (2) | |
| Benton | 38 | (2) | |
| Big Stone | W | W | Stone (crushed), stone (dimension). |
| Blue Earth | W | 2,678 | Do. |
| Brown | W | W | Clays. |
| Carlton | W | W | Peat. |
| Carver | W | (2) | |
| Cass | 188 | (2) | |
| Chippewa | W | (2) | |
| Chisago | W | (2) | |
| Clay | 3,730 | W | Lime. |
| Clearwater | W | (2) | |
| Cook | 32 | (2) | |
| Crow Wing | W | W | Manganiferous ore. |
| Dakota | 5,616 | W | Stone (crushed). |
| Dodge | W | W | Do. |
| Douglas | 418 | (2) | |
| Fillmore | 36 | 963 | Stone (crushed). |
| Freeborn | 984 | (2) | |
| Goodhue | 293 | 134 | Stone (crushed). |
| Grant | -- | 325 | Do. |
| Hennepin | 4,636 | (2) | |
| Houston | 811 | 912 | Stone (crushed). |
| Hubbard | 280 | (2) | |
| Isanti | 102 | (2) | |
| Itasca | W | W | Iron ore. |
| Kanabec | W | (2) | |
| Kandiyohi | W | (2) | |
| Kittson | W | (2) | |
| Koochiching | 85 | (2) | |
| Lac qui Parle | 107 | (2) | |
| Lake | W | (2) | |
| Lake of the Woods | 56 | (2) | |
| Le Sueur | W | W | Sand (industrial), stone (dimension). |
| Lincoln | 8 | (2) | |
| Lyon | W | (2) | |
| McLeod | 296 | (2) | |
| Mahnomen | 211 | (2) | |
| Marshall | 79 | (2) | |
| Martin | 60 | (2) | |
| Meeker | W | (2) | |
| Mille Lacs | W | W | Stone (dimension). |
| Morrison | 487 | (2) | |
| Mower | 366 | W | Stone (crushed). |
| Murray | 23 | (2) | |
| Nicollet | W | W | Stone (crushed). |
| Norman | W | (2) | |
| Olmsted | 389 | 3,233 | Stone (crushed). |
| Otter Tail | W | W | Peat. |
| Pennington | 81 | (2) | |
| Pine | W | (2) | |
| Polk | 3,343 | W | Lime. |
| Pope | 319 | (2) | |
| Ramsey | W | (2) | |
| Redwood | W | W | Clays, stone (dimension). |
| Renville | W | W | Lime, stone (dimension). |
| Rice | 345 | (2) | |
| Rock | W | (2) | |
| Roseau | 63 | (2) | |
| St. Louis | W | W | Iron ore, peat, stone (crushed). |
| Scott | W | W | Stone (crushed), sand (industrial). |
| Sherburne | 529 | (2) | |
| Sibley | W | (2) | |
| Stearns | 239 | W | Stone (dimension), stone (crushed). |
| Steele | 960 | W | Stone (crushed). |
| Stevens | W | (2) | |
| Swift | W | (2) | |
| Todd | 238 | (2) | |
| Wabasha | 282 | 395 | Stone (crushed). |
| Wadena | 35 | (2) | |
| Washington | W | W | Stone (crushed), sand (industrial). |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Minnesota, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Watonwan | $48 | (2) | |
| Wilkin | 84 | (2) | |
| Winona | 606 | $1,871 | Stone (dimension), stone (crushed). |
| Wright | 871 | W | Stone (crushed). |
| Yellow Medicine | 15 | W | Do. |
| Undistributed[3] | 1,048,893 | 1,391,492 | |
| Sand and gravel (construction) | XX | [e]53,000 | |
| Stone: | | | |
| Crushed | [e]20,900 | XX | |
| Dimension | [r] [e]10,956 | XX | |
| Total | [4] [r]1,109,142 | 1,455,030 | |

[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
XX Not applicable.

[1] The following counties are not listed because no nonfuel mineral production was reported: Cottonwood, Faribault, Jackson, Nobles, Pipestone, Red Lake, Traverse, and Waseca. County distribution for crushed and dimension stone (1982) is not available; total State values are shown separately under "Stone."

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Minnesota business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 4,132 | 4,144 | 4,162 |
| Total civilian labor force | do. | 2,166 | 2,176 | 2,229 |
| Unemployment | do. | 169 | 178 | 141 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do. | 9.5 | 8.4 | 9.4 |
| Metal mining[2] | do. | 7.7 | 6.5 | 7.4 |
| Nonmetallic minerals[3] | do. | 1.4 | 1.5 | NA |
| Manufacturing total | do. | 346.8 | 346.3 | 373.9 |
| Primary metal industries | do. | 5.6 | 5.5 | 6.2 |
| Stone, clay, and glass products | do. | 8.2 | 8.5 | 8.6 |
| Chemicals and allied products[3] | do. | 7.5 | 7.6 | NA |
| Petroleum and coal products[3] | do. | 1.6 | 1.7 | NA |
| Construction | do. | 59.9 | 60.4 | 68.4 |
| Transportation and public utilities | do. | 93.1 | 92.8 | 97.0 |
| Wholesale and retail trade | do. | 429.5 | 430.3 | 459.5 |
| Finance, insurance, real estate | do. | 98.2 | 101.2 | 106.1 |
| Services | do. | 380.8 | 392.4 | 417.8 |
| Government and government enterprises | do. | 289.6 | 286.6 | 292.0 |
| Total[4] | do. | 1,707.3 | 1,718.4 | 1,824.2 |
| Personal income: | | | | |
| Total | millions | $46,670 | $49,088 | $55,129 |
| Per capita | | $11,293 | $11,845 | $13,247 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.1 | 39.8 | 40.6 |
| Mining and quarrying[2] | | 37.6 | 35.1 | 38.5 |
| Metal mining[2] | | 37.1 | 33.5 | 37.4 |
| Total average hourly earnings, production workers | | $9.11 | $9.56 | $9.75 |
| Mining and quarrying[2] | | $13.20 | $12.23 | $12.94 |
| Metal mining[2] | | $14.11 | $13.22 | $13.82 |

See footnotes at end of table.

Table 3.—Indicators of Minnesota business activity —Continued

| | 1982$^{r}$ | 1983 | 1984$^{p}$ |
|---|---|---|---|
| Earnings by industry: | | | |
| Farm income ---- millions | $1,220 | $1,001 | $1,843 |
| Nonfarm ---- do | $32,742 | $34,942 | $38,900 |
| Mining total ---- do | $324 | $262 | $303 |
| Metal mining ---- do | $272 | $209 | $241 |
| Nonmetallic minerals ---- do | $33 | $38 | $44 |
| Manufacturing total ---- do | $8,537 | $9,081 | $10,233 |
| Primary metal industries ---- do | $151 | $157 | $194 |
| Stone, clay, and glass products ---- do | $185 | $203 | $219 |
| Chemicals and allied products ---- do | $184 | $206 | $238 |
| Petroleum and coal products ---- do | $63 | $72 | $78 |
| Construction ---- do | $1,692 | $1,812 | $2,119 |
| Transportation and public utilities ---- do | $2,697 | $2,868 | $3,112 |
| Wholesale and retail trade ---- do | $6,161 | $6,389 | $7,097 |
| Finance, insurance, real estate ---- do | $1,993 | $2,295 | $2,528 |
| Services ---- do | $6,265 | $6,889 | $7,707 |
| Government and government enterprises ---- do | $4,953 | $5,225 | $5,667 |
| Construction activity: | | | |
| Number of private and public residential units authorized | 18,955 | 24,810 | 26,226 |
| Value of nonresidential construction ---- millions | $1,006.0 | $1,045.8 | $1,300.3 |
| Value of State road contract awards ---- do | $216.0 | $272.0 | $262.7 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,145 | 1,162 | 1,218 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value ---- millions | $1,109.1 | $1,455.0 | $1,676.2 |
| Value per capita | $269 | $351 | $403 |

$^{p}$Preliminary. $^{r}$Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Minnesota Department of Economic Security.

[3] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[4] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

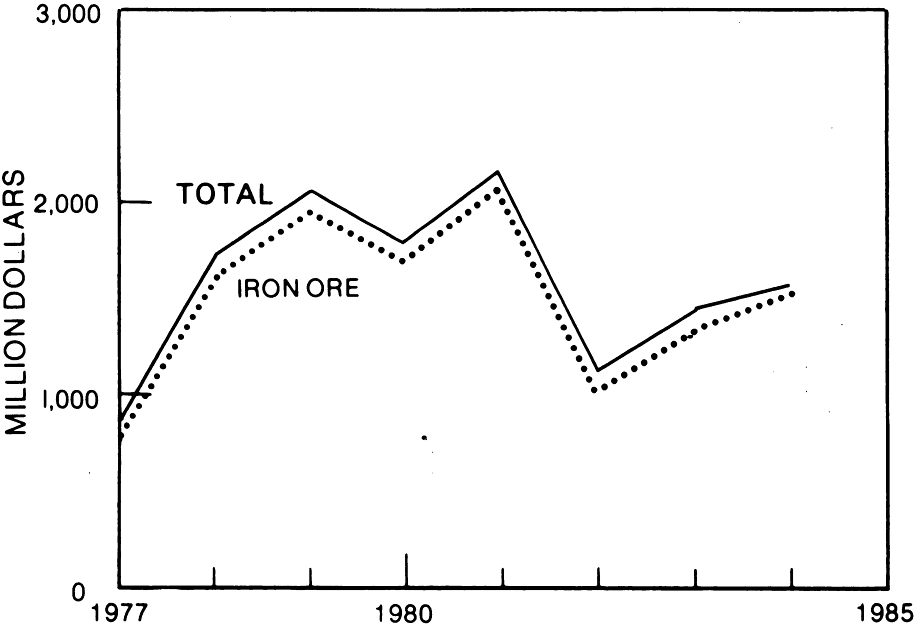

Figure 1.—Value of iron ore shipments and total value of nonfuel mineral production in Minnesota.

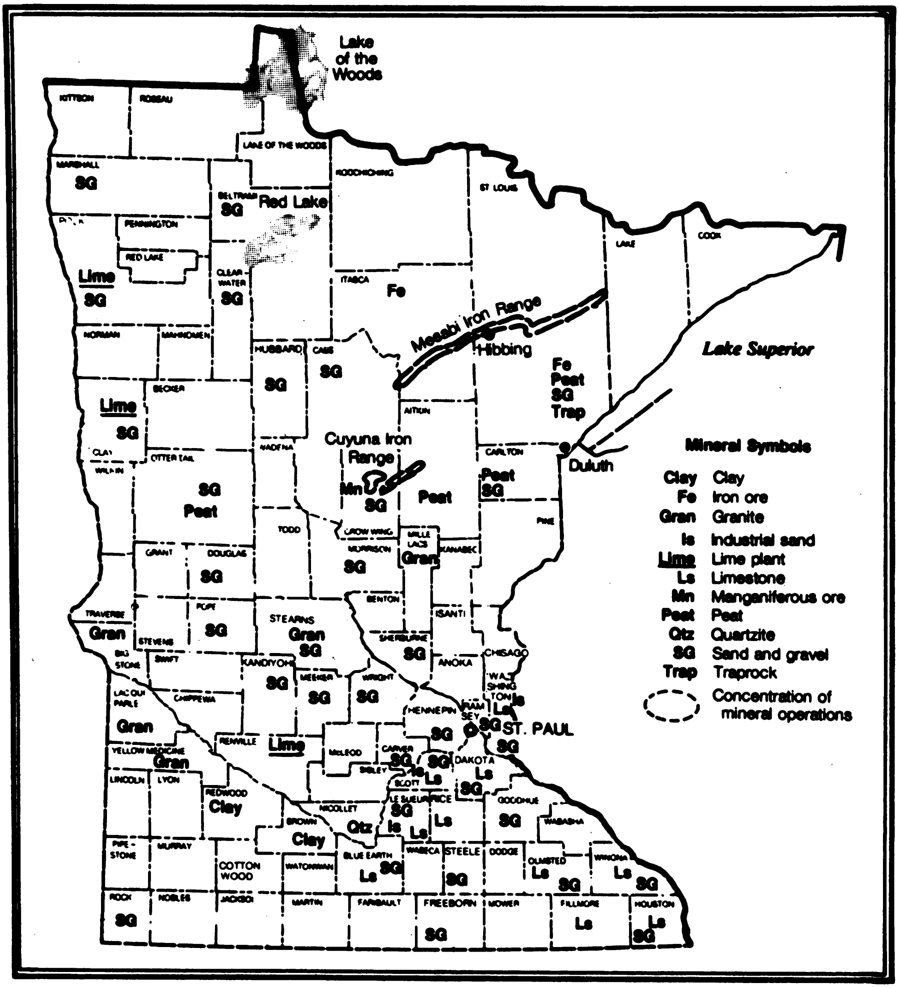

**Figure 2.—Principal mineral producing localities in Minnesota.**

The quantity of iron ore produced in Minnesota during 1984 ranked 1st among 8 producing States; manganiferous ore, 1st of 2; peat, 6th of 22; dimension stone, 10th of 32; industrial sand, 11th of 38; construction sand and gravel, 11th of 50; lime, 22d of 38; crushed stone, 28th of 48; and clay, 40th of 44.

Although the output of iron ore increased over the extremely depressed levels of the 2 previous years, a continuing weak demand for steel resulted in cutbacks and/or temporary closures at seven of the State's eight taconite pellet production facilities. During the year, taconite production was equivalent to approximately 57% of the combined installed annual production capacity of these plants.

**Employment.**—During 1984, employment in the mining and quarrying industry fluctuated significantly on a monthly basis due in part to closures, cutbacks, and restarts of the taconite pellet production facilities on the Mesabi Range. According to statistics published by the Minnesota Department of Economic Security, employment in the State's mining and quarrying industry ranged from a high of 11,200 in July to a low of 5,500 in December. Peak employment during the year was about 7% above that of 1983. Workers in the metal mining sector represented, on the average, about 79% of the total mining and quarrying work force. During 1984, the average hourly earnings of the entire mining and quarrying work force was $12.94; those in the metal mining sector received the highest hourly wage, averaging $13.82, a 5% increase over that received at the close of 1983.

**Trends and Developments.**—The State Department of Natural Resources (DNR) awarded mineral exploration leases covering 154,000 acres of State-administered lands in northern Minnesota to 12 companies and 1 individual. Of the total 352 leases awarded, Kerr-McGee Corp. of Oklahoma City received the greatest number, totaling 191 for 81,396 acres in Koochiching, Lake of the Woods, and St. Louis Counties. State officials indicated that lands near Ely and International Falls received particular attention during the lease sale as they have rock outcroppings geologically similar to greenstone belts near Hemlo in neighboring Ontario, Canada, where a recent major gold find was under development.

Exploration and drilling for nonfuel minerals in the State involved 7 companies completing drilling at 37 sites in 7 counties, according to the DNR. The DNR reported that in 1984, 16 companies renewed their registrations to engage in exploration drilling in the State.

Under criticism from environmentalists, the DNR declared a moratorium on granting leases for mineral exploration of ecologically significant peatlands. The moratorium was to remain in effect until the 1985 State legislature acted upon the matter. Environmentalists began criticizing the DNR after learning that several sensitive peatlands had been included in mineral exploration leases approved by the DNR in 1983.

The Industrial Abrasives Div. of 3M Co. began manufacturing Cubitron mineral on a production basis in new facilities in Cottage Grove. The Cubitron material was a gel-derived, Z-phase composition, 93% alumina and 7% magnesium oxide, with a minor phase of spinel. The material has high purity and does not contain fracture lines. The product, which was made in many grades, was used on grinding belts, wood-planing belts, and fiber-backed discs.

The Duluth, Missabe and Iron Range Railway announced plans to modify one of its iron ore docks in Two Harbors in an effort to cut the cost of loading Great Lakes freighters. The project would include the building of 16 pipelines inside its Dock No. 2—the main ore dock—that can load 1,000-foot ore carriers. The pipelines would enable taconite pellets stored on one side of the dock to be shifted to storage bins on the other side. The $400,000 modification project was to commence at the close of the 1984 shipping season.

**Legislation and Government Programs.**—Among the principal pieces of legislation enacted into law by the 1984 Minnesota Legislature, two impacted on the State's mineral industry.

The first, HF 2016—Omnibus Tax Bill, included the following provisions relating to taconite:

1. It freezes the current $2.08 per ton production tax for 2 years and thereafter increases it according to an index adjusted for inflation.
2. It phases out over 2 years an additional tax of up to $0.12 per ton that is based on the iron content in taconite pellets.
3. It bases taconite production taxes on a 3-year average of production. Currently, the State can base the tax on the 3-year average or the current year's production, whichever is higher.
4. It spreads over 5 years the repayment of $17.9 million in overpaid production taxes. The repayment was ordered by the Minnesota Supreme Court in a decision that upheld the legality of production taxes, but overturned the State's method of computing the taxes.

The bill also includes a $250,000 per year credit against production taxes for Reserve Mining Co. The credit, which will be in effect for 3 years, will be used to offset the cost of building a $1.5 million water filtration plant at the company's Milepost 7 tailings disposal site. In addition, the bill reduces the occupation tax on the remaining deposits of iron ore to make it comparable to that of taconite, which will cost the State about $800,000 in the next biennium.

The second, SF 881—Aggregate Planning and Protection, protects aggregate resources, promotes orderly and environmentally sound development, spreads the burden of development, introduces aggregate resource protection into local comprehensive planning and land use controls, and provides for a 15-member committee of the Metropolitan Council to prepare a report identifying sources of aggregate (sand and gravel) in the Twin Cities metropolitan area by December 31, 1985.

The Minnesota Geological Survey (MGS) during 1984 actively pursued its ongoing role of conducting research and providing data on the State's geology and water and mineral resources. Among the activities within the various geologic areas of investigation were the following:

1. Quaternary geology. As an outgrowth of a sand, gravel, and bedrock aggregate resources inventory of the Twin Cities metropolitan area, a map showing the Quaternary geology of the Minneapolis-St. Paul area was published at a scale of 1:48,000, and a map of bedrock geology and topography of the seven-county metropolitan area was published at a scale of 1:250,000.
2. Stratigraphic geology. Stratigraphic columns were published for the Northern Midcontinent Region.
3. Precambrian geology. Twenty-one core holes were drilled into basement rock in the southern part of the Animikie Basin as part of a continuing effort to elucidate the geology and economic potential of the area. Work continued on analyses of rocks for economic mineral potential and of the relationship of structural geology of the Duluth Complex to economic mineralization.
4. Hydrogeology. Work continued on karst hydrogeology in southeastern Minnesota. Hydrogeologic studies, including chemistry of ground water, continued on the University of Minnesota's aquifer thermal energy storage project.
5. Geochemistry. Freshwater stromatolites have been found in Eagle Lake, near Fergus Falls, west-central Minnesota. This is the second area in the United States known to have living freshwater stromatolites. A method is being devised to age-date the deposits, which are presumed to be younger than 10,000 years. Analyses of speleothems and ground water, using the uranium-thorium disequilibrium method, and of radon and radon daughter products in various geologic materials and locations continued.
6. Geophysics. Geophysical data roduction was completed for another large area in the continuing program of detailed aeromagnetic surveying of the State. In addition, a shaded-relief aeromagnetic anomaly map of northeastern and east-central Minnesota was published. Several hundred new gravity observations were made in the Hibbing quadrangle, and a revised Bouguer anomaly map of the quadrangle was published.
7. Computer operations. Computerization of MGS's water-well log data base continued. Geological, geochemical, and geophysical data from selected areas in northeastern Minnesota were compiled and digitized.
8. Engineering and environmental geology. The county atlas for Winona County was published, consisting of plates showing bedrock hydrogeology, bedrock geology, surficial geology, sinkholes, susceptibility of ground water to pollution, well construction, and geologic resources. In addition, a project to establish geologic criteria relevant to selection of landfill sites in Olmsted County was completed.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

**Iron Ore.**—Minnesota was the leading State in the Nation in iron ore production, contributing approximately 70% of the total usable iron ore shipped from all U.S. mines during 1984. The State's output was obtained from nine companies operating on the Mesabi Range in Itasca and St. Louis Counties at eight taconite mines, two natural ore mines, and from five locations where natural ore mined in former years was shipped from stockpile.

Taconite pellet production, which accounted for 98% of the State's usable iron production, improved slightly over that of 1983 but remained 8% below the 10-year average.

Several ownership changes occurred in the State's iron ore operations in 1984. Republic Steel Corp. merged with Jones & Laughlin Steel Corp., a wholly owned subsidiary of LTV Corp., to form LTV Steel Co. This new company assumed the 50% interest in Resorve Mining Co. and the 16% interest in Hibbing Taconite Co., both previously held by Republic Steel, and Jones & Laughlin's 35% interest in Erie Mining Co. and its wholly owned McKinley Extension natural ore mine. Armco Inc. increased its ownership of Eveleth Expansion Co., part of Eveleth Mines, from 40% to 56% by acquiring the 16% interest held by Dofasco Inc.

At the Hibbing Taconite plant near Hibbing, the year marked the first self-fluxed iron oxide pellet production in the State. The approximately 200,000-gross-ton output was utilized in trial blast furnace runs at a Canadian steelmaking plant.

### Table 4.—Minnesota: Production and shipments of usable iron ore[1]

(Thousand long tons, gross weight, unless otherwise specified)

| Year | Production | | | | Shipments | | | |
|---|---|---|---|---|---|---|---|---|
| | Natural ore and concentrates | Pellets | Total | Iron content (percent) | Natural ore and concentrates | Pellets | Total | Proportion of pellets to total ore (percent) |
| 1980 | 2,050 | 43,112 | 45,162 | 63.4 | 2,371 | 43,101 | 45,472 | 94.8 |
| 1981 | 1,698 | 49,327 | 51,025 | 63.7 | 2,719 | 47,457 | 50,176 | 94.6 |
| 1982 | 527 | 23,372 | [2]23,898 | 64.7 | 752 | 22,963 | 23,715 | 96.8 |
| 1983 | 865 | 25,390 | 26,255 | 64.4 | 1,113 | 29,586 | 30,699 | 96.4 |
| 1984 | 853 | 35,844 | 36,697 | 64.7 | 1,193 | 34,409 | 35,602 | 96.7 |

[1] Exclusive of ore containing 5% or more manganese.

[2] Data do not add to total shown because of independent rounding.

A project began on the Mesabi Range for testing a new "plasma smelting" process for producing pig iron ingots directly from iron ore concentrates, bypassing the blast furnace used in contemporary methods. The $3.2 million project, a joint venture of Pickands Mather & Co., Minnesota Power, and Westinghouse Electric Corp. and including substantial State funding, will include a prototype unit capable of producing 1,000 tons of pig iron per year. Results of the testing will be evaluated to determine the economic feasibility for possible development of a commercial-size operation on the Range.

According to figures the Lake Superior Industrial Bureau released, wages paid to employees of the State's iron ore industry totaled approximately $212 million, up from $207 million paid in 1983. Purchases of goods and services by the industry were approximately $575 million, up from $452 million in 1983.

With one exception, the published prices for various grade classifications of Lake Superior iron ore remained unchanged from those of 1983. The exception was a new price offered for pellets introduced on the market late in the year by Mineral Services Inc. that was quoted at approximately 18% to 24% less than prices of other pellet suppliers. The published prices in effect at yearend for ore delivered at rail-of-vessel at lower lake ports and based on 51.50% natural iron content were as follows: Mesabi non-Bessemer, coarse ore, $30.03 per gross ton; fine ore, $31.53 per gross ton; and manganiferous ore, $32.78 per gross ton. The lower lake price for pellets was at three levels—86.9 cents, 80.5 cents, and 66 cents per long ton iron unit. The average weighted mine value of Minnesota iron ore shipped in 1984 was $43.86 per long ton.

Published freight rates, including rail and water, for transporting iron ore from the Mesabi Range to lower lake ports, ranged from $12.28 to $13.69 per gross ton at midyear, compared with $11.70 to $13.45 per gross ton in mid-1983. These rates exclude storage and dock handling charges that may be applicable.

### Table 5.—Dates of first and final cargoes of Minnesota iron ore shipped from Upper Great Lakes ports

| Port and dock | 1983 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | First shipment | Final shipment | Total tonnage (thousand long tons) | First shipment | Final shipment | Total tonnage (thousand long tons) |
| Duluth, MN: DM&IR | Apr. 4 | Dec. 16 | 6,560 | Apr. 4 | Dec. 13 | 7,764 |
| Silver Bay, MN: Reserve | Apr. 9 | Dec. 21 | 2,717 | Apr. 12 | Dec. 14 | 3,628 |
| Superior, WI: Burlington-Northern | Apr. 5 | Dec. 21 | 8,668 | Apr. 4 | Dec. 22 | 11,150 |
| Taconite Harbor, MN: Erie | Apr. 2 | Dec. 30 | 3,861 | Apr. 10 | Dec. 11 | 3,399 |
| Two Harbors, MN: DM&IR | Apr. 1 | Dec. 28 | 8,336 | Mar. 27 | Nov. 12 | 6,805 |
| Total | | | 30,142 | | | 32,746 |

Sources: American Iron Ore Association and various issues of Skillings' Mining Review.

**Manganiferous Ore.**—Shipments of manganiferous ore (containing 5% to 35% manganese, natural) rose to the highest level of the past 3 years but remained at about one-half of the 10-year average. The State's entire output during 1984 came from the Algoma-Zeno Mine, operated by Pittsburgh Pacific Co. on the Cuyuna Range near Ironton in Crow Wing County. The manganiferous ore concentrate shipped was all processed from stockpiled crude ore mined in prior years.

**Table 6.—Minnesota: Shipments of manganiferous ores[1] from the Cuyuna Range**

| Year | Ferruginous manganese ore (10% to 35% Mn, natural) | | |
|---|---|---|---|
| | Quantity (long tons) | Contents (natural) | |
| | | Fe (percent) | Mn (percent) |
| 1980 | 106,276 | 32.00 | 14.04 |
| 1981 | 124,617 | 29.84 | 14.84 |
| 1982 | 14,560 | 28.99 | 15.66 |
| 1983 | 10,102 | 30.81 | 14.63 |
| 1984 | 60,731 | 26.36 | 12.87 |

[1] All manganiferous ore shipped from the Cuyuna Range during 1980-84 was ferruginous manganese ore containing 10% to 35% manganese. There have been no shipments of manganiferous iron ore containing 5% to 10% manganese since 1969.

## NONMETALS

**Clays.**—Common clay and shale production rose modestly over that of 1983 but remained about 46% below the 10-year average. Ochs Brick & Tile Co., the only producer in the State during 1984, obtained its raw material from pits in Brown and Redwood Counties, using it solely in the manufacture of face brick at its Springfield plant. The Ochs plant turns out more than 20 million brick per year and has the capability to manufacture hundreds of colors and textures of brick. The company makes predominantly three sizes of brick: modular, 8 inch; king size, 9-5/8 inch; and utility, 12 inch.

**Gem Stones.**—No commercial gem stone mining operations were reported in Minnesota during 1984. The value shown in table 1 represents an estimate for materials collected by rock hounds and other hobbyists.

**Lime.**—The quantity of lime produced in Minnesota during 1984 rose slightly above the level attained in 1983, but remained about 10% below the 10-year average. The total amount of domestically produced lime consumed in Minnesota during 1984 was 209,000 short tons. Of this total, a substantial amount was manufactured in-State at facilities operated by two firms. Lime production by American Crystal Sugar Co. was from plants at Crookston, East Grand Forks, and Moorhead, and by Southern Minnesota Sugar Coop. at Renville. Both companies utilized the output in their sugar refining operations at these same locations. The high-quality limestone used in manufacturing the lime all came from out-of-State sources.

**Peat.**—Five companies harvested three types of peat (sphagnum, hypnum, and reed-sedge) from bogs in four counties. The quantity and value of the material marketed during the year increased over that of 1983. Reed-sedge peat was the principal type harvested, accounting for about three-fourths of the total. Most of the material marketed was sold in packaged form and the remainder in bulk. Nearly four-fifths of the marketed material was used for general soil improvement; the remainder for a variety of uses, including bedding for nursery stock, earthworm culture medium, and golf course maintenance.

Plans were announced for a new horticultural peat operation in northern Minnesota. Peatrex Ltd. of Rockville, MD, planned to harvest and package about 15,000 short tons of sphagnum peat in the Cromwell area of northern Carlton County. The firm has a 25-year lease on a 160-acre tract of State-owned peatland.

**Perlite (Expanded).**—Conwed Corp. expanded perlite obtained from out-of-State sources at its plant in Cloquet, Carlton County. The company consumed the expanded material exclusively in its manufacture of acoustic tile and other formed products.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

In 1984, production of construction sand and gravel, the second leading commodity produced in the State in terms of quantity and value, dropped slightly from levels estimated for 1983. The average unit value for construction sand and gravel was $2.17 per ton, an increase of 1% over that marketed in 1983.

Output during the year was recorded for 207 firms and government agencies operating at 428 sites located throughout 78 of the State's 87 counties. Hennepin County was the leading county in production, followed respectively by Dakota and Washington Counties, each recording production in excess of 1 million tons and collectively accounting for nearly one-third of the State total.

Approximately 89% of the construction sand and gravel produced during 1984 was shipped by truck, and the remainder was either shipped by water or not transported.

### Table 7.—Minnesota: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,529 | $10,807 | $3.06 |
| Plaster and gunite sands | 136 | 526 | 3.87 |
| Concrete products | 510 | 1,369 | 2.68 |
| Asphaltic concrete | 3,582 | 7,292 | 2.04 |
| Road base and coverings[1] | 4,975 | 8,982 | 1.81 |
| Fill | 1,752 | 2,976 | 1.70 |
| Snow and ice control | 248 | 522 | 2.10 |
| Railroad ballast | 44 | 163 | 3.69 |
| Other[2] | 7,835 | 16,451 | 2.10 |
| Total[3] or average | 22,612 | 49,087 | 2.17 |

[1] Includes road and other stabilization (cement and lime).
[2] Includes roofing granules and other unspecified uses.
[3] Data may not add to totals shown because of independent rounding.

### Table 8.—Minnesota: Construction sand and gravel sold or used by producers, by county[1]

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Aitkin | 1 | 11 | $21 | 1 | W | W |
| Becker | 6 | 255 | 756 | 5 | 80 | $146 |
| Beltrami | 26 | 132 | 193 | 17 | 334 | 458 |
| Benton | 4 | 37 | 38 | 2 | W | W |
| Brown | 3 | 146 | 155 | 2 | W | W |
| Carlton | 5 | 294 | 508 | 4 | 256 | 485 |
| Cass | 9 | 117 | 188 | 10 | 232 | 422 |
| Clay | 13 | 1,055 | 2,928 | 27 | 967 | 2,222 |
| Clearwater | 1 | W | W | 10 | 276 | 349 |
| Cook | 1 | 10 | 32 | 1 | 14 | 28 |
| Crow Wing | 8 | 127 | 322 | 9 | 356 | 951 |
| Dakota | 11 | 2,934 | 5,616 | 11 | 2,458 | 4,784 |
| Douglas | 7 | 175 | 418 | 7 | 205 | 455 |
| Fillmore | 1 | 17 | 36 | -- | -- | -- |
| Freeborn | 5 | 447 | 984 | 6 | 420 | 954 |
| Goodhue | 5 | 134 | 293 | 6 | 273 | 1,063 |
| Hennepin | 12 | 2,102 | 4,636 | 14 | 2,637 | 6,796 |
| Houston | 20 | 238 | 811 | 20 | W | W |
| Hubbard | 14 | 121 | 280 | 17 | 331 | 848 |
| Isanti | 1 | 78 | 102 | -- | -- | -- |
| Itasca | 2 | 236 | 812 | 5 | 153 | 262 |
| Kanabec | 2 | W | W | 8 | 133 | 171 |
| Kittson | 2 | W | W | 4 | 79 | 154 |
| Koochiching | 19 | 84 | 85 | 3 | 67 | 90 |
| Lac qui Parle | 1 | 56 | 107 | 2 | 50 | W |
| Lake | 10 | W | W | 10 | 161 | 208 |
| Lake of the Woods | 14 | 56 | 56 | 14 | 55 | 55 |
| Le Sueur | 3 | 943 | 1,940 | 2 | W | W |
| Lincoln | 1 | 4 | 8 | 7 | 33 | 36 |
| Lyon | 1 | W | W | 3 | 136 | 204 |
| McLeod | 5 | 181 | 296 | 3 | 120 | 208 |
| Mahnomen | 2 | 89 | 211 | 1 | W | W |
| Marshall | 4 | 61 | 79 | 9 | 228 | 345 |
| Martin | 1 | 60 | 60 | 1 | 97 | 146 |
| Meeker | 2 | W | W | 3 | 242 | 534 |
| Mille Lacs | 1 | W | W | 3 | 197 | 421 |
| Morrison | 4 | 190 | 487 | 7 | 336 | 574 |
| Mower | 3 | 218 | 366 | 4 | 63 | 210 |

See footnotes at end of table.

### Table 8.—Minnesota: Construction sand and gravel sold or used by producers, by county[1] —Continued

| County | 1982 Number of mines | 1982 Quantity (thousand short tons) | 1982 Value (thousands) | 1984 Number of mines | 1984 Quantity (thousand short tons) | 1984 Value (thousands) |
|---|---|---|---|---|---|---|
| Murray | 2 | 23 | $23 | 6 | W | W |
| Norman | 3 | W | W | 6 | 188 | $333 |
| Olmsted | 6 | 199 | 389 | 4 | 324 | 756 |
| Otter Tail | 8 | 820 | 1,784 | 7 | 399 | 736 |
| Pennington | 3 | 43 | 81 | 3 | 81 | 156 |
| Polk | 6 | 386 | 551 | 6 | 486 | 712 |
| Pope | 4 | 137 | 319 | 4 | 208 | 418 |
| Redwood | -- | W | W | 5 | 89 | 188 |
| Renville | 2 | W | W | 2 | W | 83 |
| Rice | 3 | 313 | 345 | 4 | 66 | 119 |
| Roseau | 9 | 42 | 63 | 9 | W | W |
| St. Louis | 14 | 736 | 1,403 | 20 | 894 | 2,019 |
| Sherburne | 6 | 268 | 529 | 6 | 330 | 754 |
| Stearns | 4 | 93 | 239 | 4 | 739 | 1,280 |
| Steele | 6 | 580 | 960 | 6 | 389 | 721 |
| Swift | 10 | W | W | 9 | 94 | 120 |
| Todd | 4 | 196 | 238 | 5 | 133 | 178 |
| Wabasha | 2 | 84 | 282 | 2 | 169 | 458 |
| Wadena | 2 | W | W | 3 | 77 | 105 |
| Washington | 11 | 1,945 | 4,282 | 11 | 1,995 | 3,886 |
| Watonwan | 2 | W | W | 1 | 27 | 57 |
| Wilkin | 2 | 50 | 84 | 1 | W | W |
| Winona | 4 | 191 | 606 | 4 | 205 | 673 |
| Wright | 4 | 209 | 871 | 6 | 291 | 574 |
| Undistributed[2] | [r]26 | 3,355 | 8,351 | 36 | 4,439 | 11,184 |
| Total[3] | 373 | 20,276 | 44,222 | 428 | 22,612 | 49,087 |

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Faribault, Grant, Nobles, Pipestone, Traverse, and Waseca Counties are not listed because no production was reported.

[2] Includes Anoka, Big Stone (1982), Blue Earth, Carver, Chippewa, Chisago, Cottonwood (1984), Dodge, Jackson (1984), Kandiyohi, Nicollet, Pine, Ramsey, Red Lake (1984), Rock, Scott, Sibley, Stevens, and Yellow Medicine Counties; sand and gravel that cannot be assigned to specific counties (1984); and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—Industrial sand was produced in Le Sueur, Scott, and Washington Counties. Output increased markedly over that of 1983. The average unit price of the material marketed was $18.01 per ton, a 5% decrease compared with that of 1983. Included among the uses for which the sand was marketed were a proppant for the oil industry in a process known as hydrofracturing to enhance oil well production, glass containers, and for foundry use.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Crushed stone produced during 1984 was estimated to have increased approximately 4% in quantity and 2% in value compared with 1983. The average unit price for the material marketed was estimated at $2.90 per short ton.

*Dimension.*—The estimated output of dimension stone during 1984 increased both in quantity and value over that of 1983 by 39% and 18%, respectively. Granite accounted for the bulk of the production, which was marketed principally for monumental and cut stone purposes. Minnesota ranked 10th among the 32 States for which dimension stone production was estimated. Lesser quantities of limestone were also quarried for dimension stone use.

Cold Spring Granite Co. announced a $5.0 million expansion that would involve construction of a new four-building facility near Cold Spring for producing thin granite sheets, about 1-inch thick. The new facility would have state-of-the-art equipment that would reduce production costs and enable the company to compete better with the thin, low-cost foreign granites that have been imported in large quantities during the last 4 years. The existing operations that produce 3- to 4-inch thick granite slabs and other products will continue to operate unchanged.

Delano Granite Inc. of Delano filed for bankruptcy on March 26, 1984. This one-time major producer of granite monuments closed its plant late in 1983.

**Sulfur (Recovered).**—Sulfur was recovered as a byproduct of the petroleum refining operations of Koch Refining Co., a division of Koch Industries Inc., near Pine Bend in Dakota County, and of Northwestern Refining Co., a division of Ashland Oil Inc., near St. Paul Park in Washington County. Sales increased 20% in quantity and 23% in value compared with those of 1983.

**Vermiculite (Exfoliated).**—W. R. Grace & Co., at a plant in Hennepin County, exfoliated processed vermiculite obtained from out-of-State sources. Sales of the exfoliated material decreased in quantity and value compared with 1983 levels. Approximately two-thirds of the output was marketed for loose fill and block insulation; the remainder was used in fireproofing and concrete and plaster aggregate applications.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN.

### Table 9.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays and shale: | | | |
| Ochs Brick & Tile Co | Box 106<br>Springfield, MN 56087 | Pits and plants | Brown and Redwood. |
| Iron ore: | | | |
| The Hanna Mining Co.: | 100 Erieview Plaza<br>Cleveland, OH 44114 | | |
| Butler Taconite Project | | Mine, concentrator, agglomerator. | Itasca. |
| National Steel Pellet Project | | do | Itasca and St. Louis. |
| Inland Steel Mining Co.: | 30 West Monroe St.<br>Chicago, IL 60603 | | |
| Minorca | | do | St. Louis. |
| LTV Steel Co., Northwest Ore Div.: | Box 196<br>Aurora, MN 55705 | | |
| McKinley Extension | | Mine and concentrator. | Do. |
| Oglebay Norton Co.: | 1100 Superior Ave.<br>Cleveland, OH 44114 | | |
| Eveleth Mines | | Mine, concentrator, agglomerator. | Do. |
| Pickands Mather & Co.: | 1100 Superior Ave.<br>Cleveland, OH 44114 | | |
| Erie Commercial | | do | Do. |
| Hibbing Taconite Co | | do | Do. |
| Pittsburgh Pacific Co.: | 2521 1st Ave.<br>Hibbing, MN 55746 | | |
| Connie, Donora, Pittsburgh Pacific Fee, and Silver. | | Stockpile shipments. | Do. |
| Reserve Mining Co.: | Silver Bay, MN 55614 | | |
| Peter Mitchell | | Mine and primary crusher. | Do. |
| Silver Bay plant | | Concentrator and agglomerator. | Lake. |
| Rhude & Fryberger Inc.: | Box 66<br>Hibbing, MN 55746 | | |
| Rana | | Mine and plant | St. Louis. |
| Sharon Culver | | Stockpile shipments. | Do. |
| United States Steel Corp. Minnesota Ore Operations: | Box 417<br>Mountain Iron, MN 55768 | | |
| Minntac | | Mine, concentrator, agglomerator. | Do. |
| Lime: | | | |
| American Crystal Sugar Co | 101 North 3d St.<br>Moorhead, MN 56560 | Quicklime and shaft kilns. | Clay and Polk. |
| Southern Minnesota Sugar Coop | Box 500<br>Renville, MN 56284 | do | Renville. |
| Manganiferous ore: | | | |
| Pittsburgh Pacific Co.: | 2521 1st Ave.<br>Hibbing, MN 55746 | | |
| Algoma-Zeno | | Stockpile shipments. | Crow Wing. |
| Peat: | | | |
| Great Lakes Peat Products Co | 2305 Ford Parkway<br>St. Paul, MN 55116 | Bog and processing plant. | St. Louis. |
| Michigan Peat Co | Box 66388<br>Houston, TX 77006 | do | Carlton. |
| Peat Resources Inc | 700 North Lilac Dr.<br>Golden Valley, MN 55422 | do | Aitkin. |
| Power-O-Peat Co | Box 956<br>Gilbert, MN 55741 | do | St. Louis. |
| Tamarack Peat Moss Co | Underwood, MN 56586 | do | Otter Tail. |

## Table 9.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Perlite (expanded): | | | |
| Conwed Corp | Box 43237<br>St. Paul, MN 55164 | Plant | Carlton. |
| Sand and gravel: | | | |
| Construction: | | | |
| Arsenal Sand & Gravel Co | Box 12707<br>New Brighton, MN 55112 | Pit and plant | Ramsey. |
| Barton Sand & Gravel Co | 10633 89th Ave. North<br>Osseo, MN 55369 | Pits and plants | Benton, Dakota, Hennepin, Sherburne, Washington, Wright. |
| Fischer Construction Co. Inc | 6801 West 150th St.<br>Apple Valley, MN 55124 | Pit and plant | Dakota. |
| C. S. McCrossan Inc | Box 322<br>Osseo, MN 55369 | do | Hennepin. |
| North Star Concrete Co | Box 167<br>Mankato, MN 56001 | Pits and plants | Le Sueur and Nicollet. |
| J. L. Shiely Co | 1101 North Snelling Ave.<br>St. Paul, MN 55108 | Pit and plant | Washington. |
| Stommes Construction Co | Route 4<br>St. Cloud, MN 56301 | do | Stearns. |
| Industrial: | | | |
| Minnesota Frac Sand Co., a division of J. L. Shiely Co. | 1101 North Snelling Ave.<br>St. Paul, MN 55108 | do | Scott. |
| Twin City Silica Ltd | 499 Cottage Grove Dr.<br>Woodbury, MN 55125 | do | Washington. |
| Unimin Corp | 258 Elm St.<br>New Canaan, CT 06840 | Pits and plants | Le Sueur. |
| Stone: | | | |
| Crushed (1983): | | | |
| Granite: | | | |
| Cold Spring Granite Co | Cold Spring, MN 56320 | Quarries and plant | Stearns. |
| The Green Co. Inc | 200 14th Ave.<br>Granite Falls, MN 56241 | Quarry and plant | Yellow Medicine. |
| Ortonville Stone Co., a subsidiary of L. G. Everist Inc. | Box 829<br>Sioux Falls, SD 57102 | do | Big Stone. |
| J. L. Shiely Co | 1101 North Snelling Ave.<br>St. Paul, MN 55108 | do | Stearns. |
| Limestone: | | | |
| Bryan Rock Products Inc | Box 215<br>Shakopee, MN 55379 | Quarries and plants. | Scott and Washington. |
| Edward Kraemer & Sons Inc. | 1000 West 122d St.<br>Burnsville, MN 55337 | Quarry and plant | Dakota. |
| Mankato Aglime & Rock Co | Box 254<br>Mankato, MN 56001 | do | Blue Earth. |
| Mathy Construction Co., Patterson Quarries Div. | Route 3, Box 15<br>St. Charles, MN 55972 | Quarries and plants. | Olmsted, Wabasha, Winona. |
| Midwest Asphalt Corp., River Warren Aggregates Inc. | Box 338<br>Hopkins, MN 55343 | Quarry and plant | Scott. |
| Quarve & Anderson Co | 2430 Marion Rd. SE.<br>Rochester, MN 55901 | Quarries and plants. | Dodge, Goodhue, Olmsted, Wabasha, Winona. |
| J. L. Shiely Co | 1101 North Snelling Ave.<br>St. Paul, MN 55108 | do | Scott and Washington. |
| Quartzite: | | | |
| New Ulm Quartzite Quarries Inc. | Route 5, Box 21<br>New Ulm, MN 56073 | Quarry and plant | Nicollet. |
| Traprock (basalt): | | | |
| Arrowhead Blacktop Co | Box 6568<br>Duluth, MN 55806 | do | St. Louis. |
| Dimension (1983): | | | |
| Granite: | | | |
| Cold Spring Granite Co | Cold Spring, MN 56320 | Quarries | Big Stone, Mille Lacs, Renville. |
| Do | | Quarries and plant | Stearns. |
| View Quarry Co., a division of Rex Granite Co. | Box 924<br>St. Cloud, MN 56302 | Quarry and plant | Redwood. |
| Limestone: | | | |
| Biesanz Stone Co. Inc | Box 768<br>Winona, MN 55987 | do | Winona. |
| Minnesota Quarries Inc | Box 1358<br>Mankato, MN 56002 | do | Blue Earth. |
| Vetter Stone Co | Route 5, Box 41<br>Mankato, MN 56001 | do | Le Sueur. |
| Sulfur (recovered): | | | |
| Koch Refining Co., a division of Koch Industries Inc. | Box 2302<br>Wichita, KS 67201 | Elemental sulfur recovered as a byproduct of oil refining. | Dakota. |
| Northwestern Refining Co., a division of Ashland Oil Inc. | Drawer 9<br>St. Paul Park, MN 55071 | do | Washington. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co., Construction Products Div. | 62 Whittemore Ave.<br>Cambridge, MA 02140 | Processing plant | Hennepin. |

# The Mineral Industry of Mississippi

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Geology and Energy Resources, Mississippi Department of Natural Resources, for collecting information on all nonfuel minerals.**

**By James R. Boyle,[1] Maylene E. Hubbard,[2] and Alvin R. Bicker[3]**

The value of Mississippi's nonfuel mineral industry in 1984 was $94.2 million, an increase of 5% over that of 1983. Although relatively small, the increase continued an upward trend that has lasted for 2 years. Mississippi's weak economy began to recover substantially early in the year, but the onset of higher interest rates affected the economy severely after midyear, resulting in only a minor recovery.

Mississippi ranked second nationally in the production of recovered sulfur, and third in bentonite and fuller's earth. Major commodities produced were cement, clays, sand and gravel, and stone. Although output increased, total value was still below the peak years of 1978 through 1980. The increased output was attributed to a slight upturn in construction activities, which peaked by midyear. Mississippi ranked 41st nationally in value of nonfuel minerals produced.

**Table 1.—Nonfuel mineral production in Mississippi[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays ________ thousand short tons | 1,446 | $23,846 | 2,398 | $30,565 |
| Sand and gravel (construction) ________ do | [e]11,000 | [e]34,600 | 12,205 | 34,955 |
| Stone (crushed) ________ do | 1,651 | 4,377 | [e]2,000 | [e]5,800 |
| Combined value of cement and sand and gravel (industrial) | XX | 26,882 | XX | 22,858 |
| Total | XX | 89,705 | XX | 94,178 |

[e]Estimated. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Mississippi, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adams | W | (2) | |
| Benton | W | W | Clays. |
| Bolivar | $227 | (2) | |
| Carroll | W | (2) | |
| Clay | W | W | Stone (crushed). |
| Copiah | 4,814 | (2) | |
| DeSoto | 2,751 | (2) | |
| Forrest | W | (2) | |
| George | 40 | (2) | |
| Hancock | 81 | (2) | |
| Harrison | 40 | (2) | |
| Hinds | W | $736 | Clays. |
| Holmes | W | (2) | |
| Itawamba | 1,654 | (2) | |
| Jackson | W | W | Sand and gravel (industrial). |
| Jasper | 54 | (2) | |
| Jefferson Davis | 16 | (2) | |
| Jones | W | W | Clays. |
| Kemper | W | W | Do. |
| Lauderdale | W | W | Do. |
| Lincoln | W | (2) | |
| Lowndes | W | W | Cement, stone (crushed), clays. |
| Marion | 1,260 | (2) | |
| Marshall | W | W | Clays. |
| Monroe | 7,373 | 5,952 | Do. |
| Noxubee | W | W | Clays, stone (crushed). |
| Panola | W | W | Clays. |
| Pearl River | 353 | (2) | |
| Perry | 11 | (2) | |
| Pike | W | (2) | |
| Rankin | (3) | -- | |
| Smith | (3) | W | Stone (crushed). |
| Stone | W | (2) | |
| Tippah | W | W | Clays. |
| Tishomingo | W | W | Stone (crushed), sand and gravel (industrial). |
| Walthall | 154 | (2) | |
| Warren | W | (2) | |
| Washington | W | (2) | |
| Wayne | (3) | 216 | Stone (crushed). |
| Winston | W | W | Clays. |
| Yalobusha | W | (2) | |
| Yazoo | W | (2) | |
| Undistributed[4] | 53,854 | 48,199 | |
| Sand and gravel (construction) | XX | [e]34,600 | |
| Stone (crushed) | W | XX | |
| Total[5] | 72,685 | 89,705 | |

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[e] Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No nonfuels mineral production was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Crushed stone was produced; data not available by county. Total State value is shown separately under "Stone (crushed)."

[4] Includes mineral preduction that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to totals shown because of independent rounding.

## Table 3.—Indicators of Mississippi business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 2,567 | 2,581 | 2,598 |
| Total civilian labor force | do. | 1,065 | 1,064 | 1,074 |
| Unemployment | do. | 117 | 134 | 116 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do. | 11.8 | 8.8 | 9.2 |
| Nonmetallic minerals except fuels[2] | do. | .9 | .7 | NA |
| Oil and gas extraction | do. | 11.0 | 8.1 | 8.4 |
| Manufacturing total | do. | 203.2 | 204.7 | 218.6 |
| Primary metal industries[2] | do. | 12.5 | 12.2 | NA |
| Stone, clay, and glass products | do. | 5.7 | 5.7 | 6.2 |
| Chemicals and allied products | do. | 6.5 | 6.5 | 6.8 |
| Petroleum and coal products | do. | 1.9 | 2.1 | 2.1 |
| Construction | do. | 39.6 | 36.2 | 37.6 |
| Transportation and public utilities | do. | 39.6 | 38.6 | 39.1 |
| Wholesale and retail trade | do. | 161.6 | 165.2 | 175.5 |
| Finance, insurance, real estate | do. | 32.9 | 33.5 | 34.2 |
| Services | do. | 122.1 | 124.6 | 125.5 |
| Government and government enterprises | do. | 180.0 | 181.1 | 183.5 |
| Total[3] | do. | 790.0 | 792.8 | 823.1 |
| Personal income: | | | | |
| Total | millions | $19,939 | $20,810 | $22,802 |
| Per capita | | $7,762 | $8,062 | $8,777 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.1 | 40.1 | 40.6 |
| Total average hourly earnings, production workers | | $6.41 | $6.70 | $6.95 |
| Earnings by industry: | | | | |
| Farm income | millions | $467 | $332 | $748 |
| Nonfarm | do. | $13,275 | $18,918 | $15,081 |
| Mining total | do. | $380 | $257 | $278 |
| Nonmetallic minerals except fuels | do. | $14 | $12 | $18 |
| Oil and gas extraction | do. | $366 | $245 | $265 |
| Manufacturing total | do. | $3,404 | $3,448 | $4,503 |
| Primary metal industries | do. | $69 | $76 | $93 |
| Stone, clay, and glass products | do. | $106 | $114 | $125 |
| Chemicals and allied products | do. | $155 | $164 | $186 |
| Petroleum and coal products | do. | $74 | $91 | $99 |
| Construction | do. | $867 | $798 | $793 |
| Transportation and public utilities | do. | $1,015 | $1,056 | $1,124 |
| Wholesale and retail trade | do. | $2,087 | $2,229 | $2,445 |
| Finance, insurance, real estate | do. | $583 | $649 | $702 |
| Services | do. | $1,984 | $2,160 | $2,341 |
| Government and government enterprises | do. | $2,785 | $2,935 | $3,123 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 6,207 | 9,770 | 10,877 |
| Value of nonresidential construction | millions | $169.3 | $205.9 | $254.8 |
| Value of State road contract awards | do. | $108.0 | $202.0 | $235.2 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 712 | 767 | 850 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $72.7 | $89.7 | $94.2 |
| Value per capita | | $28 | $35 | $36 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

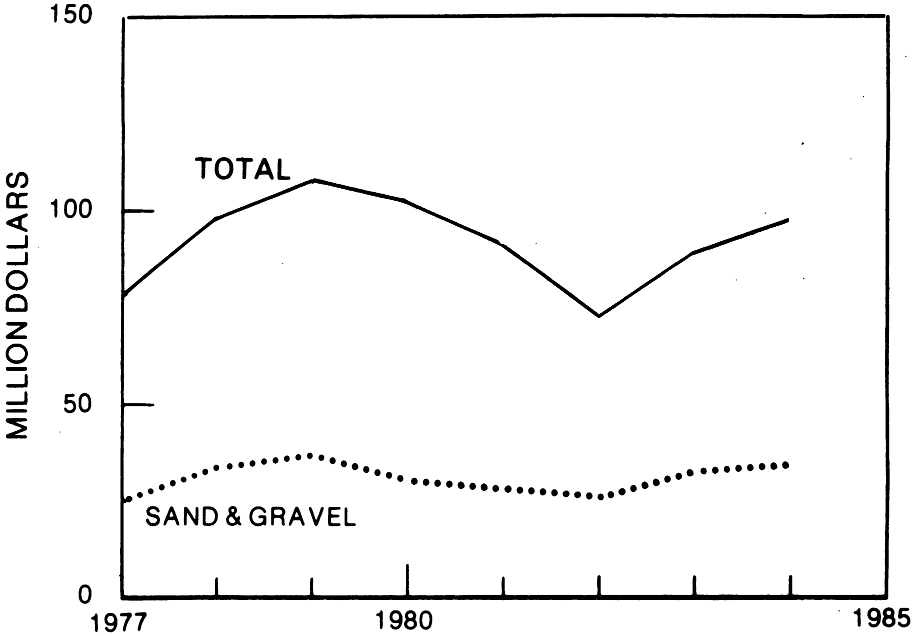

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Mississippi.

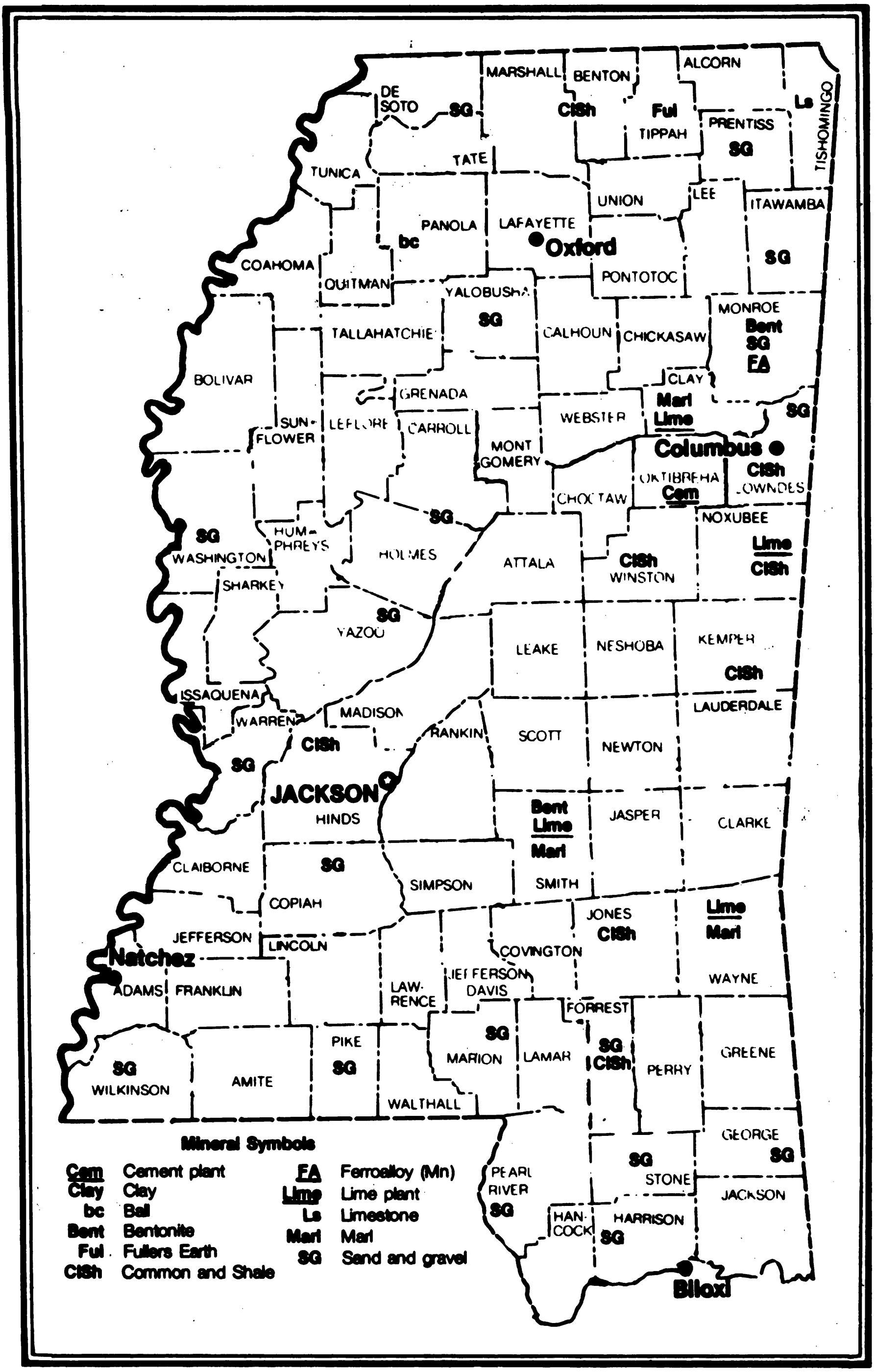

Figure 2.—Principal mineral producing localities in Mississippi.

**Trends and Developments.**—Mississippi's limited output of minerals is tied closely to construction activities. The unemployment rate, which also mirrors construction activity, declined to 9.5% at midyear as construction activity increased. The rate then rose sharply in the fourth quarter to 11.0% with declines in construction-related manufacturing sectors. Rising interest rates during the second quarter triggered the decline in Mississippi's interest-sensitive construction, textile, and apparel industries.[4] The State's recovery still remains one of the weakest in the Southeast.

Mississippi's exports of manufactured products grew faster than production and generated about 9% of its manufacturing jobs,[5] leaving the State vulnerable to new economic setbacks because of the relatively high proportion of its work force in manufacturing. The production tax on sand and gravel and crushed stone, in essence a severance tax, increased to 6%, up from 5% in 1983. However, with the exception of operations in direct competition with nearby out-of-State operations, this tax had a minimal impact on output.

The Tennessee-Tombigbee Waterway was completed during 1984 and was expected to open early in 1985. Producers were adversely impacted by the completion as demand for sand and gravel and crushed stone fell. Maintenance requirements for the waterway and the Mississippi River amount to about 1 million short tons of stone per year. The major portion of these requirements are for the Mississippi River and are obtained from sources in Arkansas and Tennessee. Renovation and expansion have been started at port facilities at Mobile, AL, Gulfport and Pascagoula, MS, and Pensacola, FL, with ready access to the Port of New Orleans for worldwide shipping. Major commodities expected to move over the new waterway include aggregate, chemicals, coal, metallic ores, nonmetallic minerals, petroleum, and steel.

Development of the Tennessee-Tombigbee Waterway could be a positive influence on Kerr-McGee Chemical Corp. to continue developing its Hamilton facility. The Hamilton facility consists of titanium dioxide, electrolytic manganese, and chemical plants. About 100,000 short tons of material per year, currently shipped by rail, could be transported on the waterway. In 1984, the titanium dioxide plant completed a $4 million expansion program and increased production capacity to 63,000 tons per year. In the latter part of the year, the company announced a second expansion of $8 million to increase production to 72,000 tons per year. The expansion, to be completed by mid-1986, will result in about 20 new permanent jobs. Feedstock for the plant comes from Kerr-McGee's Mobile, AL, synthetic rutile plant, which should be able to supply all of the needs of the expanded Hamilton plant.

The Mississippi Department of Economic Development (MDED) announced 19 expansions in mineral-related industries during 1984. The expansions were noted as follows: clay industry (eight), steel and foundries (six), concrete products (two), sand and gravel (two), and titanium dioxide (one).

During fiscal year 1984, 177,428 short tons of ilmenite from Australia was imported through the Port of Gulfport and shipped to E. I. du Pont de Nemours & Co.'s titanium dioxide operations at Pass Christian. This was a slight increase over that of 1983.

KemaNord Inc. announced planned expansions for its sodium chlorate plant in Columbus to increase production from 58,000 to 98,000 short tons per year by midyear 1985. Sodium chlorate is used to bleach pulp and as an oxidizing agent in the uranium industry. KemaNord is the U.S. subsidiary of KemaNord AB of Sweden, which will become the world's largest producer of sodium chlorate with expansions announced in 1984. Salt from Louisiana will be barged up the Tennessee-Tombigbee Waterway to the plant.

Phelps Dodge Corp. sold its Starkville building wire and cable plant and its related businesses to Hi-Tech Cable Corp., a new independent company made up of the management at the Starkville plant. The plant's major product is copper building wire, and the new owners announced plans to continue and strengthen the existing operation.

In the energy sector, the oil and gas industry, despite weakening prices, improved in 1984 over depressed activity levels of 1983. Employment was up 4% as drilling activity increased slightly; output from producing wells also increased slightly over that of 1983. Although lignite reserves in the State were estimated at over 5 billion short tons, plans to develop this resource have been indefinitely delayed.

**Legislation and Government Programs.**—During the year, the Mississippi Bureau of Geology and Energy Resources continued investigation of the geology and mineral resources of the State. The Surface Section completed field investigations in Newton County and initiated work in Tishomingo County. The Subsurface Section prepared regional subsurface maps and maintained the Sample and Core Library. The Mineral Lease Section leased State-owned lands for mineral exploration. Income derived from leasing, royalty, and permit activity totaled $432,000 during the year. The Groundwater Section completed 244 electric logs of water wells and began obtaining ground water data in Alcorn and Tishomingo Counties. An "Economic Minerals Map of Mississippi" and a "Minerals Producers Directory—1984" were published during the year. The Surface Mining Section continued to administer the Surface Mining Act of 1977.

The Mississippi Mineral Resources Institute at Oxford continued mineral resources investigations during the year. Programs conducted included studies of heavy minerals offshore, utilization of zeolite and various clay types, examination of Landsat reflectivity, and several energy related studies involving both lignite and oil and gas. The institute continued an ongoing program designed to aid in the commercialization of minerals in the State. The program emphasized research to identify minerals with potential for development and methods to assist bringing those minerals into development. In fiscal year 1984, the U.S. Bureau of Mines allotted $150,000 to the institute to foster and support graduate education in mineral sciences and engineering.

Late in the year, the U.S. Bureau of Land Management (BLM) identified 78 parcels of land in Mississippi covering 6,013 acres of unleased Federal land presumed to contain oil and gas leases. BLM proposed to publish a notice in 1985 detailing the location of these unleased parcels to determine priority of leasing.

The U.S. Bureau of Mines placed a $100,000 contract with Jackson State University, Jackson, to study the characteristics of respirable mine dust.

The U.S. Geological Survey conducted various basic geologic and geophysical studies within the State of Mississippi. The Survey published Professional Paper 1300, "Wilderness Mineral Potential," which includes the Sandy Creek Roadless Area in Mississippi. The report was prepared in cooperation with the U.S. Bureau of Mines.

The U.S. Department of the Interior scheduled a meeting late in the year with representatives of seven coastal State governors, including Mississippi, to discuss issues under section 8(g) of the Outer Continental Shelf Lands Act. Section 8(g) requires the Secretary of the Interior to offer the Governor of the affected State the opportunity to enter into a fair and equitable agreement concerning the disposition of revenues generated by a Federal lease within 3 miles of the seaward boundary of the State containing pools of oil and gas that underlie both State and Federal waters. No agreement was reached during the year.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

Nonmetals accounted for all of Mississippi's nonfuel mineral production in 1984. Commodities produced included cement, clays, sand and gravel, and crushed stone.

**Cement.**—United Cement Co. was the sole producer of cement in Mississippi. The plant, in Artesia, Lowndes County, is in the east-central part of the State. The company's primary output was portland cement, with minor amounts of masonry cement. Portland cement shipments decreased along with unit prices; masonry cement output increased.

Principal portland cement sales were to ready-mixed concrete companies, concrete product manufacturers, highway contractors, and building materials dealers. Raw materials used in cement manufacture included anhydrite, chalk, gypsum, iron ore, limestone, and sand. Clay was not required because of the high alumina content in the stone. The raw material is crushed, ground, and fired with finely ground coal in the kiln. After grinding with gypsum, the cement was shipped to markets in States in the Southeast.

**Clays.**—Total clay output increased substantially over that of 1983. Seventeen mining companies operated 24 pits in 12 counties, primarily in the northern and northeastern part of the State. Ball clay, bentonite, common clay, and fuller's earth were produced in Mississippi. The State ranked third nationally in output of bentonite and fuller's earth. Clays produced in the State were used in the automotive, construction, agricultural, and animal-feed industries.

Output of common clay and fuller's earth increased, while bentonite decreased and ball clay remained at the same level as that of 1983. Common clay was mined at 18 pits, primarily in Benton, Noxubee, and Hinds Counties. Major uses were for brick, concrete block, and structural concrete. Output was 1,871,000 short tons compared with 943,000 tons in 1983; this was the highest output in over 10 years. The resurgence of construction activities through midyear had a direct effect on brick companies in the State. Several companies operated at or near capacity throughout the year. Merry Co., Augusta, GA, which purchased 50% of Laurel Brick & Tile Co. in 1982, purchased the remaining portion in mid-1984. Holly Springs Brick & Tile Co. announced a $4.5 million expansion program at its plant in Holly Springs.

Ky-Tenn Clay Co. was the only producer of ball clay in Mississippi; output was from a surface mine in Panola County. The clay was processed for a variety of ceramic uses with demand remaining at a relatively low level. The product was shipped to markets primarily out of State with some going to export markets. Columbus Brick Co., Columbus, and Schneider Brick Co., Brookhaven, announced expansion plans through MDED.

**Table 4.—Mississippi: Clays sold or used by producers**

(Thousand short tons and thousand dollars)

| Year | Bentonite | | Ball clay, fire clay, fuller's earth | | Common clay | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value |
| 1980 | 275 | 6,234 | W | W | 1,054 | 3,292 | 1,596 | 21,714 |
| 1981 | 285 | 7,060 | W | W | 649 | 2,028 | 1,218 | 23,309 |
| 1982 | 232 | 6,063 | W | W | 330 | 1,212 | 805 | 21,181 |
| 1983 | 241 | 5,952 | W | W | 943 | 2,694 | 1,446 | 23,846 |
| 1984 | 208 | 6,304 | W | W | 1,871 | 5,631 | 2,398 | 30,565 |

W Withheld to avoid disclosing company proprietary data; included in "Total."

Mississippi's bentonite producers, American Colloid Co., Harshaw-Filtrol Partnership, and International Minerals & Chemical Corp. (IMC) operated four surface mines in Monroe County. Bentonite was processed for sale to the automotive industry, as a foundry binder, and to the agricultural industry for use as an animal-feed binder. Demand remained relatively low with shipments mainly to out-of-State markets. Filtrol announced an expansion of its clay desiccant facility at Jackson, which would double capacity. Clay desiccants are used as dehumidifying agents to prevent corrosion and mildew. Plant modernization of more than $1 million would include a new dryer, roll crusher, and improved storage facilities and was scheduled for completion in 1985. The calcium montmorillonite was shipped by rail from Monroe County to Jackson. Filtrol is developing a pit in Smith County with ongoing tests to determine suitability of the material. American Colloid Co. plans to produce 15,000 tons per year of acid-activated clay at its new $3.5 million facility at Aberdeen. The plant is scheduled to start up by mid-1985. Acid-activated clay is used to bleach and decolorize vegetable oils and animal fats and to refine mineral oils. IMC also announced expansion plans through MDED.

Two companies, IMC and Oil-Dri Production Co., mined fuller's earth from pits in Tippah County. The clay was processed at nearby plants for sale to the agricultural industry. Markets for fuller's earth remained low with production slightly higher than that of 1983. Oil-Dri announced expansion plans through MDED.

**Nitrogen.**—Cargill Inc., Chevron Chemical Co., and Mississippi Chemical Co. produced anhydrous ammonia during 1984. Total rated annual capacity of the three facilities was 991,000 short tons.

**Perlite (Expanded).**—Mississippi ranked first in the Nation in output of expanded perlite. Manville Products Corp., Natchez, and the United States Gypsum Co., Greenville, expanded perlite shipped in from New Mexico. The product was used in roof insulation and in formed products. Production and value increased over that of 1983.

**Sand and Gravel.**—Mississippi produced both construction and industrial sand and gravel in 1984. Production was from 100 companies operating 107 pits in 35 counties. Total output increased over that of 1983. None of the operations in the State produced over 1 million short tons in 1984.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel was the leading commodity in value among the nonfuel minerals produced in Mississippi. Although production increased, it still has not returned to its peak production years of the 1970's. The increase in 1984 was basically due to a surge in construction activities, including highway work. Construction sand and gravel was produced at 105 operations in 34 counties. Leading counties were DeSoto, Copiah, and Holmes. The major portion of sand and gravel was shipped by truck. Valley Gravel Co., Bigbee Valley, and R. C. Cement Co., Hernando, announced expansion plans at their pits through MDED; the cost will exceed $4 million.

**Table 5.—Mississippi: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Asphaltic concrete | 1,186 | $3,623 | $3.05 |
| Concrete aggregate | 3,334 | 11,840 | 3.55 |
| Concrete products | 53 | 178 | 3.36 |
| Fill | 76 | 87 | 1.14 |
| Plaster and gunite sands | 4 | 12 | 3.00 |
| Road base and coverings[1] | 1,166 | 2,652 | 2.27 |
| Other[2] | 6,387 | 16,563 | 2.59 |
| Total or average | [3]12,205 | 34,955 | 2.86 |

[1] Includes road and other stabilization (lime).

[2] Includes roofing granules and other unspecified uses.

[3] Data do not add to total shown because of independent rounding.

*Industrial.*—Sand for industrial uses was produced by two companies in Jackson and Tishomingo Counties. Output decreased; the material was used in sandblasting, cores, and molds.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. The data for even-numbered years are based on annual company estimates made before yearend.

Crushed stone output was estimated to have increased mainly because of increased construction and road maintenance activities that started late in 1983 and continued through most of 1984; demand for agricultural purposes decreased.

**Sulfur (Recovered).**—Mississippi ranked second nationally in output of recovered sulfur. Five companies recovered sulfur from refinery and natural gases. Production was reported by Shell Oil Co. in Clarke and Rankin County; Chevron U.S.A. Inc. in Jackson County; Amerada Hess Corp. in Lamar County; Pursue Gas Processing & Petrochemical Co. in Rankin County; and Koch Hydrocarbon Co. in Clarke County. Sulfur sold or used in 1984 totaled 754,000 metric tons, valued at $74.4 million, compared with 722,000 metric tons valued at $67.9 million in 1983.

## METALS

Primary metal production is not a significant industry in the State, yet contributed to the economic well-being of Mississippi. Although the major production of the State's extractive mineral industry was nonmetallic, a significant metals industry existed that depended mainly on out-of-State raw materials. According to the Mississippi Research & Development Center, eight companies produced gray iron castings and three produced steel castings. Shipments of ferroalloys decreased 15.3% while value decreased 8.0%, indicating an increase in unit values. Kerr-McGee operated an electrolytic manganese facility at Hamilton utilizing pyrolusite from Gabon, West Africa.

Corhart Refractories Co. Inc., Pascagoula, imported chrome ore from the Republic of South Africa for the production of refractories. The primary use is in the form of chromite to make refractory bricks for lining metallurgical furnaces.

Six primary metal companies announced expansion plans through MDED at a cost of over $3.5 million. Companies announcing expansion projects included ESCO Corp. (Newton), Forging Die Inc. (Olive Branch), Gipson Steel Inc. (Meridian), Shelby Die Casting Co. Inc. (Shelby), Teledyne Irby Steel Co. (Gulfport), and Vicksmetal Corp. (Vicksburg).

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[3] State geologist, Bureau of Geology and Energy Resources, Jackson, MS.

[4] Wilson, G., and G. Sullivan. Mississippi: Moving Ahead, But Slowly. Economic Review, Federal Reserve Bank of Atlanta, Feb. 1985, pp. 69-76.

[5] Business America. State Export Series, Mississippi. Nov. 26, 1984, p. 15.

## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| United Cement Co | Box 185<br>Artesia, MS 39736 | Plant | Lowndes. |
| Clays: | | | |
| American Colloid Co | Box 75<br>Aberdeen, MS 39730 | Mine and plant | Monroe. |
| Holly Springs Brick & Tile Co | Box 310<br>Holly Springs, MS 38635 | | |
| International Minerals & Chemical Corp | Box 346A<br>Aberdeen, MS 39730 | Mine | Do. |
| Jackson Ready Mix Concrete, a division of Delta Industries Inc. | Box 1292<br>Jackson, MS 39205 | do | Hinds. |
| Sand and gravel: | | | |
| American Sand & Gravel Co | Box 272<br>Hattiesburg, MS 39401 | Stationary plant | Forrest. |
| Blain Gravel Co | Box 278<br>Mount Olive, MS 39119 | Stationary plants | Clay, Copiah, Itawamba, Marion. |
| Hammett Gravel Co | Box 207<br>Lexington, MS 39095 | Mines and plants | Holmes, Marion, Pike. |
| Stone (crushed): | | | |
| Mississippi Stone Products | Box 338<br>Iuka, MS 38852 | Quarry | Tishomingo. |
| State Department of Agriculture and Commerce. | Box 1609<br>Jackson, MS 39205 | Quarries | Clay, Noxubee, Wayne. |
| United Cement Co | Box 185<br>Artesia, MS 39736 | Quarry | Lowndes. |

# The Mineral Industry of Missouri

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Missouri Department of Natural Resources, Division of Geology and Land Survey, for collecting information on all nonfuel minerals.**

## By Jane P. Ohl,[1] Heyward M. Wharton,[2] and Ardel W. Rueff[2]

The total value of nonfuel minerals produced in Missouri increased from $725.9 million in 1983 to $731.9 million in 1984, and Missouri's rank in the Nation as a nonfuel mineral producer remained at eighth. Missouri maintained its national dominance in the production of fire clay and lead; was third in barite, lime, and zinc; fifth in portland cement; and seventh in crushed stone.

In 1984, 14 nonfuel minerals were mined in the State, 6 metals and 8 nonmetals. Metals accounted for more than one-third of the total value. Portland cement was Missouri's leading mineral product and accounted for more than 20% of total mineral value, including mineral fuels. Mine output of recoverable lead declined by nearly 131,000 metric tons in 1984 and was the lowest production since 1968—before three of the new Viburnum Trend lead-zinc mines were in full operation.

Per capita value of nonfuel mineral production was $146, compared with the national average of $98.

**Table 1.—Nonfuel mineral production in Missouri[1]**

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Cement: | | | | |
| Masonry thousand short tons | 146 | $7,339 | 143 | $7,033 |
| Portland do | 3,499 | 157,249 | 3,981 | 178,225 |
| Clays[2] do | 1,418 | 11,848 | 1,575 | 14,666 |
| Copper (recoverable content of ores, etc.) metric tons | 7,725 | 13,033 | 5,818 | 8,575 |
| Gem stones | NA | 10 | NA | 10 |
| Iron ore thousand long tons | 877 | 27,054 | 1,370 | W |
| Lead (recoverable content of ores, etc.) metric tons | 409,280 | 195,620 | 278,329 | 156,766 |
| Sand and gravel: | | | | |
| Construction thousand short tons | [e]7,700 | [e]17,700 | 7,967 | 19,364 |
| Industrial do | 600 | 7,541 | 614 | 8,129 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 2,021 | 23,124 | 1,401 | 11,406 |
| Stone (crushed) thousand short tons | 39,454 | 120,700 | [e]41,600 | [e]137,000 |
| Zinc (recoverable content of ores, etc.) metric tons | 57,044 | 52,052 | 45,458 | 48,707 |
| Combined value of barite, clays (fuller's earth), iron oxide pigments (crude), lime, stone (dimension), and value indicated by symbol W | XX | [r]92,598 | XX | 142,016 |
| Total | XX | [r]725,868 | XX | 731,897 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fuller's earth; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Missouri, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Andrew | (2) | W | Stone (crushed). |
| Audrain | $1,485 | W | Clays. |
| Barry | (2) | $728 | Stone (crushed). |
| Barton | (2) | W | Do. |
| Bates | (2) | W | Do. |
| Benton | (2) | W | Do. |
| Bollinger | W | (3) | |
| Boone | W | W | Stone (crushed), clays. |
| Buchanan | -- | W | Stone (crushed). |
| Butler | W | W | Stone (crushed), clays. |
| Caldwell | (2) | W | Stone (crushed). |
| Callaway | W | W | Stone (crushed), clays. |
| Camden | 132 | 578 | Stone (crushed), stone (dimension). |
| Cape Girardeau | W | W | Cement, stone (crushed), clays. |
| Cass | (2) | 769 | Stone (crushed). |
| Cedar | (2) | W | Do. |
| Christian | (2) | 1,186 | Do. |
| Clark | 170 | W | Do. |
| Clay | W | 5,021 | Do. |
| Clinton | (2) | W | Do. |
| Cole | 479 | W | Do. |
| Cooper | W | 806 | Do. |
| Crawford | W | W | Clays, stone (crushed). |
| Dade | (2) | W | Stone (crushed). |
| Dallas | (2) | W | Do. |
| Daviess | W | W | Do. |
| De Kalb | (2) | W | Do. |
| Dent | (2) | (3) | |
| Douglas | 43 | W | Stone (crushed). |
| Franklin | W | W | Stone (crushed), clays. |
| Gasconade | W | 4,163 | Clays, stone (crushed). |
| Gentry | W | W | Stone (crushed). |
| Greene | W | W | Lime, stone (crushed). |
| Grundy | W | 793 | Stone (crushed). |
| Harrison | (2) | 562 | Do. |
| Henry | (2) | -- | |
| Hickory | (2) | W | Stone (crushed). |
| Holt | (2) | W | Do. |
| Howard | W | W | Do. |
| Howell | W | W | Do. |
| Iron | 192,461 | 183,611 | Lead, zinc, silver, copper, stone (crushed), stone (dimension). |
| Jackson | W | W | Cement, stone (crushed). |
| Jasper | (2) | 5,142 | Stone (crushed). |
| Jefferson | W | W | Cement, stone (crushed), sand (industrial). |
| Johnson | (2) | 519 | Stone (crushed). |
| Knox | (2) | W | Do. |
| Laclede | (2) | 480 | Do. |
| Lafayette | 69 | W | Do. |
| Lawrence | (2) | W | Do. |
| Lewis | 681 | W | Do. |
| Lincoln | W | 294 | Do. |
| Livingston | W | W | Clays, stone (crushed). |
| McDonald | (2) | W | Stone (crushed). |
| Madison | 18 | (3) | |
| Maries | W | W | Clays. |
| Marion | (2) | W | Stone (crushed). |
| Mercer | (2) | W | Do. |
| Miller | W | 54 | Do. |
| Moniteau | (2) | 60 | Do. |
| Monroe | (2) | W | Do. |
| Montgomery | W | W | Clays, stone (crushed). |
| Morgan | (2) | W | Stone (crushed). |
| Newton | (2) | 464 | Do. |
| Nodaway | (2) | W | Do. |
| Oregon | W | 15 | Do. |
| Osage | W | W | Clays. |
| Ozark | 11 | (3) | |
| Pemiscot | 225 | (3) | |
| Perry | 10 | W | Stone (crushed). |
| Pettis | (2) | W | Do. |
| Phelps | 152 | 702 | Do. |
| Pike | 41,644 | W | Cement, stone (crushed), clays. |
| Platte | W | W | Stone (crushed), clays. |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Missouri, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Polk | (2) | W | Stone (crushed). |
| Pulaski | $165 | W | Do. |
| Putnam | (2) | W | Do. |
| Ralls | 27,321 | W | Cement, stone (crushed), clays. |
| Randolph | (2) | $535 | Stone (crushed). |
| Ray | (2) | -- | |
| Reynolds | 127,277 | 73,648 | Lead, zinc, silver, copper. |
| St. Charles | W | W | Stone (crushed), sand (industrial). |
| St. Clair | (2) | -- | |
| St. Francois | W | W | Lime, stone (crushed). |
| Ste. Genevieve | W | W | Do. |
| St. Louis | W | W | Stone (crushed), sand (industrial). |
| St. Louis City | 773 | (3) | |
| Saline | (2) | 1,879 | Stone (crushed). |
| Scotland | (2) | W | Do. |
| Scott | 68 | W | Do. |
| Shannon | (2) | W | Do. |
| Shelby | (2) | W | Do. |
| Stoddard | W | W | Clays. |
| Stone | (2) | W | Stone (crushed). |
| Sullivan | (2) | 290 | Do. |
| Taney | 190 | W | Do. |
| Texas | 23 | W | Do. |
| Vernon | (2) | 992 | Do. |
| Warren | W | W | Stone (crushed), clays. |
| Washington | 66,343 | 55,521 | Iron ore, lead, zinc, silver, copper, barite, iron oxide pigments. |
| Wayne | (2) | 4,075 | Stone (crushed). |
| Webster | 10 | 58 | Do. |
| Worth | (2) | W | Do. |
| Wright | (2) | W | Do. |
| Undistributed[4] | [r]159,790 | 365,222 | |
| Sand and gravel (construction) | XX | [e]17,700 | |
| Stone: | | | |
| Crushed | [e]113,300 | XX | |
| Dimension | [e]13 | XX | |
| Total[5] | [r]732,856 | 725,868 | |

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[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones and stone that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to totals shown because of independent rounding.

## Table 3.—Indicators of Missouri business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 4,942 | 4,963 | 5,008 |
| Total civilian labor force | do | 2,308 | 2,347 | 2,379 |
| Unemployment | do | 213 | 232 | 172 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 7.1 | 6.3 | 6.0 |
| Metal mining[2] | do | 2.5 | 2.0 | NA |
| Nonmetallic minerals except fuels[2] | do | 2.8 | 2.6 | NA |
| Coal mining[2] | do | 1.6 | 1.6 | NA |
| Oil and gas extraction[2] | do | .2 | .2 | NA |
| Manufacturing total | do | 406.8 | 405.4 | 430.9 |
| Primary metal industries | do | 13.5 | 12.4 | 13.8 |
| Stone, clay, and glass products | do | 10.8 | 11.0 | 11.1 |
| Chemicals and allied products | do | 28.1 | 27.6 | 28.8 |
| Petroleum and coal products[2] | do | 1.3 | 1.2 | NA |
| Construction | do | 73.3 | 74.7 | 82.2 |
| Transportation and public utilities | do | 133.2 | 132.7 | 133.9 |
| Wholesale and retail trade | do | 459.8 | 463.7 | 480.4 |
| Finance, insurance, real estate | do | 108.9 | 111.8 | 113.8 |
| Services | do | 405.1 | 419.3 | 434.8 |
| Government and government enterprises | do | 328.2 | 323.3 | 332.8 |
| Total[3] | do | 1,922.4 | 1,937.0 | 2,014.7 |

See footnotes at end of table.

Table 3.—Indicators of Missouri business activity —Continued

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Personal income: | | | | |
| Total | millions | $51,679 | $54,648 | $60,847 |
| Per capita | | $10,458 | $11,010 | $12,151 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.1 | 40.1 | 40.6 |
| Total average hourly earnings, production workers | | $8.46 | $8.89 | $9.32 |
| Earnings by industry: | | | | |
| Farm income | millions | $585 | $151 | $794 |
| Nonfarm | do | $36,515 | $39,501 | $43,722 |
| Mining total | do | $201 | $187 | $195 |
| Metal mining | do | $72 | $66 | $54 |
| Nonmetallic minerals except fuels | do | $53 | $52 | $61 |
| Coal mining | do | $63 | $61 | $72 |
| Oil and gas extraction | do | $13 | $7 | $8 |
| Manufacturing total | do | $9,199 | $9,829 | $11,136 |
| Primary metal industries | do | $388 | $369 | $422 |
| Stone, clay, and glass products | do | $248 | $267 | $293 |
| Chemicals and allied products | do | $851 | $901 | $983 |
| Petroleum and coal products | do | $46 | W | W |
| Construction | do | $1,899 | $2,083 | $2,476 |
| Transportation and public utilities | do | $3,845 | $4,178 | $4,454 |
| Wholesale and retail trade | do | $6,589 | $6,830 | $7,531 |
| Finance, insurance, real estate | do | $2,075 | $2,398 | $2,643 |
| Services | do | $7,144 | $7,962 | $8,833 |
| Government and government enterprises | do | $5,459 | $5,922 | $6,329 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 11,544 | 18,728 | 24,541 |
| Value of nonresidential construction | millions | $882.4 | $875.6 | $982.5 |
| Value of State road contract awards | do | $162.0 | $364.0 | $390.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 1,278 | 1,420 | 1,698 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $732.9 | $725.9 | $731.9 |
| Value per capita | | $148 | $146 | $146 |

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

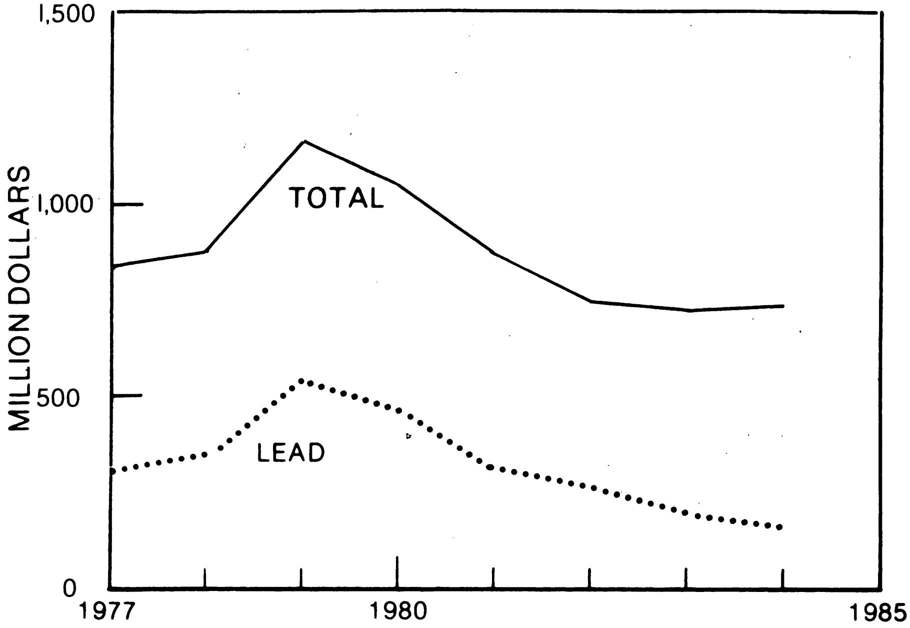

Figure 1.—Value of lead and total value of nonfuel mineral production in Missouri.

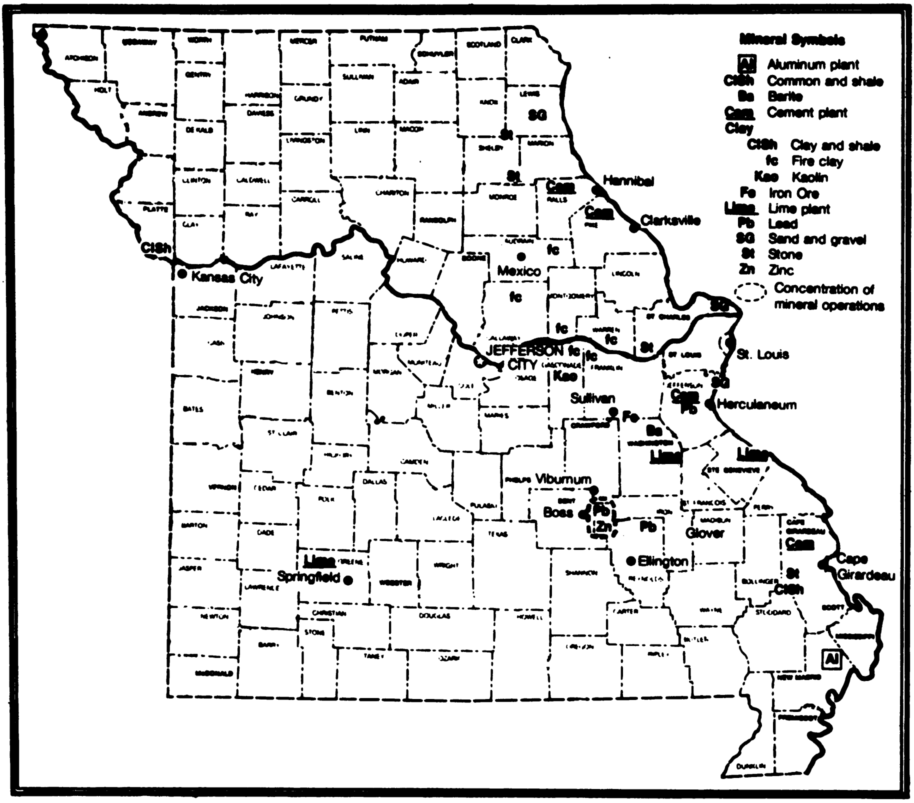

Figure 2.—Principal mineral producing localities in Missouri.

**Trends and Developments.**—A landmark decision on January 24, 1984, by the National Labor Relations Board allowed companies to relocate jobs, even to other States, to avoid paying higher union wages.

Strikes at lead-zinc mines significantly reduced metal output and reduced union strength in Missouri.

In an effort to educate the public and preserve a valuable part of the U.S. heritage, the Missouri Department of Natural Resources began restoration of the old Federal lead-zinc-copper mill No. 3 in Flat River, St. Francois County. About $1.2 million in State funds, generated by a 0.1% sales tax for State parks and soil conservation, along with $20,000 given by St. Joe Minerals Corp., will be used to restore the historic site. The Federal mill and historic site are in St. Joe State Park, an 8,500-acre tract donated to the State by St. Joe Minerals in 1972. The initial phase of the project—the establishment of a museum that will interpret mineral resources, mining history, and mining technology—was expected to be opened to the public in early 1986.

**Employment.**—According to the Missouri Department of Labor and Industrial Relations, Division of Employment Security, unemployment claims in the quarrying and mining category fell during the last quarter of 1984. An increase of 200 mining employees (from 3,500 to 3,700) in the St. Louis, MO-IL, metropolitan area between December 1983 and December 1984, was the area showing the greatest change.

Missouri had 394 mineral establishments, of which 24 were metal mining establishments and 265 were industrial mineral establishments, according to the Nation's latest 5-year survey, taken in 1982. Employees in these two groups numbered 2,600 and 2,800, respectively, in 1982, down from 3,400 and 2,900, respectively, at the time of the 1977 survey.[3]

**Environment.**—In early 1984, the Environmental Protection Agency (EPA) issued a final rule limiting particulate emissions from new plants started after August 24, 1982. The final rule limits the concentration of particulates in stack emissions to 0.05 gram per cubic meter, based on the use of the best demonstrated technology; in this case, high-energy wet scrubbers. Plants affected are those that process metallic ores into concentrates containing one or more of the following: aluminum, copper, gold, iron, lead, molybdenum, silver, titanium, tungsten, uranium, zinc, and zirconium.[4]

All primary and secondary lead smelter-refineries and lead-acid battery manufacturing plants were required to submit final compliance plans for the U.S. Department of Labor's Occupational Safety and Health Administration's (OSHA) in-plant maximum permissible exposure limit standard of 50 micrograms of lead per cubic meter of air by August 1, 1984. The operational deadline was June 29, 1991, for primary smelter-refineries.

On January 30, OSHA, the United Steelworkers of America, and ASARCO Incorporated agreed on feasible engineering controls to reduce worker exposure to lead at four of the company's plants, including Asarco's smelter at Glover. OSHA officials discussed similar agreements with AMAX Inc. and St. Joe Lead Co. The agreements called for improving ventilation, enclosing some processes or workplaces, increasing cleanup methods, providing filtered-air clean rooms, and conducting research to develop or locate additional controls to further reduce lead exposure.[5]

A cooperative tailings stabilization program was discussed at a March meeting between the U.S. Bureau of Mines and representatives of St. Joe Minerals, Cominco American Incorporated, AMAX Lead Co. of Missouri, Barr Engineering Co., and the Missouri Department of Natural Resources.

In April, in the eastern Independence area, two houses sank several feet, presumably owing to roof subsidence at the Pixley Mine. A survey in May found that four houses had been located over the abandoned underground limestone mine.[6]

As of mid-1984, five abandoned-mine land-reclamation projects in the State were completed at a cost of more than $4 million. In addition, 1 project was in the construction phase and 10 projects were in the design phase, at an estimated cost of approximately $17.2 million, according to the Missouri Department of Natural Resources.

Missouri's future mined lead output would be affected by the EPA announcement in early August that it was considering reducing the permissible amount of lead in gasoline to 0.1 gram per gallon from the 1.1-gram-per-gallon standard in effect since November 1, 1982. The reduction was to become effective January 1, 1988; later, the effective date was moved up to January 1, 1986. An interim limit of 0.5 gram was set for July 1, 1985. At yearend 1984, a total ban was being considered for January 1, 1988. Such a large reduction of lead in gasoline would reduce that particular end use of lead by a significant amount per year.

The State Division of Health and the Jefferson County Health Department, at the suggestion of St. Joe Lead at Herculaneum, planned to test children living near Missouri's lead smelters for lead in blood. Treatment for lead contamination is thought advisable when someone is found to have 25 or more micrograms of lead for each 100 milliliters of blood.

The Hazardous and Solid Waste Amendments Act, Public Law 98-616, was enacted on November 8, amending the Solid Waste Disposal Act of 1965, the Resource Conservation and Recovery Act of 1976, and the Solid Waste Disposal Act amendments of 1980. Under Public Law 98-616, lead mine, concentrator, and smelter-refinery effluents, including those associated with any solid or sludge, would be classified as hazardous if the concentration of lead or its compounds was 500 parts per million or greater, and/or the pH was less than or equal to 2.0.

**Exploration Activities.**—Base metal exploration, primarily for lead and zinc, continued to decline during 1984. In October, Noranda Exploration Inc. of Lakewood, CO, and Greenwich Resources (U.S.) Inc. agreed to form a joint venture to acquire and explore mining properties in Missouri and four other Western States. Also still involved in exploration were AMAX Exploration, Asarco, Cominco American, Getty Mines Ltd., Newmont Mining Corp., St. Joe Minerals, United States Borax & Chemical Corp., United States Steel Corp., and Utah International Inc.

**Legislation and Government Programs.**—In March, the U.S. Congress approved Interstate Cost Estimate legislation that gave the U.S. Department of Transportation authority to disburse collected Federal Highway Trust Fund construction funds to the States. The action was 6 months late and released only one-half of the funds already available in the trust fund. Most funds were being used for highway construction and repair work, and their late release affected the demand for crushed stone.

On May 21, the President signed Public Law 98-289 establishing a wilderness in the Mark Twain National Forest, southeastern Missouri. The law designated 16,500 acres as the Irish Wilderness in northeastern Oregon County, and, to accommodate mineral exploration, excluded 1,070 acres in the northwestern part of the proposed 17,562-acre parcel. The excluded acreage is near a promising southern extension of the Viburnum Trend—the world's largest lead producing area from which 86.5% of the Nation's lead was mined in 1984.

On August 29, the President signed Public Law 98-409, the Mining and Mineral Resources Research Institute Amendments, which reauthorized and streamlined the Minerals Resources Institute program operated by the U.S. Bureau of Mines. The funds were to be matched at least 1-1/2 times by non-Federal funds; those in Missouri came largely from the State coffers.

Such funds were to be used to expand the scope of research on mining and mineral processing and to operate at a higher level of activity at the University of Missouri-Rolla's Generic Mineral Technology Center for Pyrometallurgy.

On the basis of ore values from mining in the Mark Twain National Forest in calendar year 1984, royalty payments to the Federal Government amounted to $4.4 million. More than 73% of the lead concentrates produced in Missouri during the year originated from Federal leases. From the $5,744,560 collected by the Federal Government from all users of the Mark Twain National Forest, mineral rents and royalties paid by mining companies accounted for $3,608,000, or 63%, of total revenues in fiscal year 1984. The Federal Government paid 25% of its receipts, or $1,436,140, to the State to be divided among the 29 counties with acreages in the National Forest, plus $647,585 in payments in lieu of taxes, for a total of $2,083,725. Dent, Iron, Reynolds, and Washington Counties, combined, received 23% of that total.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

Mining along the Viburnum Trend, or New Lead Belt, began in 1960. Since that time, more than 133 million short tons of ore have been mined, containing more than $5.1 billion in copper, lead, silver, and zinc values: copper,[7] $248.2 million; lead, $3,957.1 million; silver, $215.0 million; and zinc, $697.4 million. Sulfuric acid, cadmium, and, possibly, other minor metals in the concentrates were recovered at some of the primary smelters, and research on cobalt and nickel recovery from these lead-zinc ores continued in 1984.

**Aluminum.**—Primary aluminum production in Missouri increased nearly 30%, and value, 48% over 1983 levels. Noranda Aluminum Inc. continued to operate its 204,000-metric-ton-per-year, three-potline aluminum plant at New Madrid, in the Missouri Bootheel. The New Madrid plant was coal powered.

Alumina was supplied by Kaiser Aluminum & Chemical Corp. of Baton Rouge, LA, and by Friguia of Guinea. Bauxite, the raw material for the alumina manufacture, was supplied by Kaiser Jamaica Bauxite Co. and Friguia.

The smelter supplied ingot to its associated plants producing rod, extrusions, and sheet and foil, and to the commercial market, and accounted for more than 4% of the total U.S. aluminum capacity in 1984. In late October, as worldwide demand for primary aluminum fell, Noranda Aluminum reduced its 1,376-person work force by 130 to 150 employees.

**Cobalt and Nickel.**—Although considerable quantities of cobalt and nickel were believed to remain in the old Madison Mine at Fredericktown, Madison County,[8] Anschutz Mining Corp. announced in April that it was discontinuing its Madison Mine cobalt project. At midyear, Inspiration Mines Inc. announced that it had signed a letter of intent that could lead to a joint venture agreement for development of the project. The tentative agreement had been terminated, however, by December.

The U.S. Bureau of Mines, in cooperation with the University of Missouri-Rolla, continued work to develop an economic cobalt and nickel extraction method. The lead-zinc ores in the Viburnum Trend were known to carry values of these two strategic metals, but their prices (cobalt, $10.40 per pound; nickel, $2.22 per pound) did not encourage mining and recovery.

**Copper.**—Copper was recovered from ores at all seven lead-zinc mines. Production fell nearly 25%, and value 34%, compared with 1983 figures. Average producer unit price of copper cathode in 1984 was 66.8 cents per pound. Missouri was 1 of only 10 States to produce copper during 1984, ranking sixth among those States.

**Iron Ore.**—Missouri ranked third of 10 States to produce iron ore in 1984. Output increased about 56% over that of calendar year 1983. Pea Ridge Iron Ore Co., a subsidiary of St. Joe Minerals, in turn a subsidiary of Fluor Corp., operated the only iron ore mine in the State—the only underground iron ore mine in the Nation—in northwestern Washington County, near Sullivan.

The annual capacity of the Pea Ridge mining facility was 2.5 million long tons of ore, and that of the plant, 1.6 million long tons of iron ore pellets.

In 1984, the mine produced about 1.9 million long tons, average grade 45% iron, and the plant produced about 1.2 million tons of self-fluxing "olivine" pellets, according to Fluor's 10K Annual Report for the fiscal year ending October 31, 1984. Mine output increased nearly 63% over that of 1983.

The Pea Ridge iron ore deposit was composed principally of magnetite, and lesser amounts of specular hematite. Proven ore reserves were approximately 166.25 million tons containing approximately 56% iron.

Pea Ridge was the only domestic producer of iron ore pellets that was not affiliated with a steelmaker. The mine's location provided a freight advantage in shipping to the firm's principal customer. The published freight rate for shipping Pea Ridge ore to Granite City, IL, by rail was $6.41 per long ton, unchanged from that of 1983, and about one-third the amount charged for iron ore shipments by rail from the Mesabi Range in Minnesota to Granite City.

Four iron deposits were known but undeveloped in southeast Missouri. St. Joe Minerals owned the Kratz Spring deposit in southern Franklin County and the Camels Hump deposit in southern Crawford County. Gold Fields Mining Corp. and Granite City Steel Div. of National Steel Corp. owned the Bourbon deposit in northeastern Crawford County. Cominco American and Dresser Industries Inc. shared an interest in the Boss copper-iron deposit in eastern Dent County.

**Lead.**—Missouri's mines accounted for 86.5% of the Nation's much reduced total lead output in 1984, compared with a 91.1% share in 1983. Total mine production of recoverable lead from the State's seven lead mines decreased 32% from that of 1983 and was the lowest production since 1968, about 2 years before the Viburnum Trend operations came fully on-stream. Total value decreased 20% from that of 1983. Average unit price for lead in 1984 was 25.5 cents per pound. The reduced production was the result of prolonged strikes at the Nation's two largest integrated primary lead producers' facilities—St. Joe Lead and AMAX. Strikes at these companies' mines, which began in the spring, were settled in December.

Among the 25 leading lead producing mines nationwide, Missouri's mines were ranked first (Buick), second (Magmont), third (Fletcher), fourth (Viburnum No. 29), sixth (Viburnum No. 28), seventh (Viburnum No. 35), and eighth (Brushy Creek).

According to AMAX Inc.'s 10K Annual Report, the Buick Mine, mill, and smelter-refinery in Iron County, equally owned by AMAX's subsidiary AMAX Lead, the operator, and Homestake Mining Co., continued to be the Nation's largest single lead producing unit.

Buick milled 1.36 million metric tons of ore at an average grade of 8.1% lead, compared with 1.93 million tons at an average grade of 7.9% in 1983, according to the company's 1984 annual report. Production was down nearly 30% from that of 1983, owing to a strike by the United Steelworkers of America from May 31 to December 29, 1984. During the strike, the mine, mill, and smelter were operated at reduced capacity using management personnel and workers brought in from other AMAX operations. On December 29, a new 37-month contract was ratified by local 7447.

Estimated ore reserves at the Buick Mine at yearend 1984 were 32.75 million tons of ore, down 1.65 million tons, at an average grade of 5.6% lead, down 0.1% from yearend 1983.

The principal areas to be mined by AMAX were held under long-term Federal mineral leases. The principal lease expires in 2013. Pursuant to the lease terms, royalty payments of 5% of the gross value of the minerals mined were paid to the U.S. Government.

In late June 1984, AMAX was restructuring its metals group and expected considerable cost savings and some staff reductions.

In the restructuring, a new base metal and precious metal division was to include the lead and zinc division formerly at Clayton,[9] and Clayton office personnel and functions were transferred to the new metals group headquarters at Greenwich, CT.

Asarco continued preliminary underground development at its new West Fork Mine, Reynolds County, and expected to be completed in the first quarter of 1985. When in full operation, West Fork was expected to be capable of processing 3,130 metric tons of ore per day and producing 41,730 metric tons of lead in concentrates per year. Ore reserves were estimated to be 13.6 million tons, averaging 5.5% lead, 1.2% zinc, 0.04% copper, and 0.30 ounce of silver per ton.[10]

Cominco American, a subsidiary of Cominco Ltd. of Canada, and Dresser Industries jointly owned the Magmont Mine in Iron County. According to Cominco Ltd.'s 1984 annual report, 1.01 million metric tons of ore was milled at an average grade of 7.1% lead, down 0.1% from that of 1983. In August, the mine attained its highest ever monthly production of total concentrates—14,300 tons.

In the new Magmont West area, which was opened November 21, 1982, higher-than-average zinc grades and improved mining equipment efficiencies helped to set a new annual record high for total concentrate production.

Total measured and indicated reserves at the Magmont at yearend 1984 were estimated to be 7.17 million tons, grading 6.5% lead, 1.2% zinc, and 0.4 ounce of silver per ton, according to the Cominco American 1984 annual report. The average lead grade, however, dropped from 8.0% in 1983 to 6.5% in 1984. Cominco American's share of the Magmont Mine's lead production was purchased by Asarco's lead smelter-refinery at Glover, and Dresser's share was tolled by Asarco.

Ozark Lead Co., a subsidiary of Kennecott, did not operate in 1984. At yearend, Ozark Lead's estimated ore reserves (proved and probable) were 22.9 million metric tons, and recoverable lead and zinc were approximately 1.1 million tons and 90,000 tons, respectively. Recoverable silver was estimated at 4.1 million troy ounces.[11]

St. Joe Minerals, the largest integrated producer of lead in the United States, operated five lead-zinc mines and three mills in southeastern Missouri and accounted for about 34% of domestic recoverable lead output in 1984. According to Fluor's 10K Annual Report, covering its fiscal year ending October 31, 1984, St. Joe Minerals' five mines produced 122,700 metric tons of lead in concentrates.

St. Joe Minerals' Fletcher Mine in Reynolds County was the Nation's third largest producing lead mine during the year. St. Joe Minerals' other mines were Brushy Creek (shut down indefinitely in April 1984 at the beginning of the strike), Viburnum No. 28, Viburnum No. 29, and Viburnum No. 35.

Viburnum No. 35 Mine at Bixby began production of lead, zinc, and copper August 15, 1983; the ore was processed at the company's nearby Viburnum mill, which was expanded in 1983 to accommodate the new mine's anticipated 3,600-ton-per-day ore production. The completed mill expansion and mine development project cost $31.5 million. Further development of Viburnum No. 35 continued; at capacity, St. Joe Minerals expected to produce 41,000 tons of lead annually at the new operation.

The three mills treated 2.67 million metric tons of ore, grading 4.76% lead, a tonnage decrease of 36% from that of fiscal year 1983, and the concentrates produced were shipped to St. Joe Lead's smelter at Herculaneum, Jefferson County.

A strike involving 553 United Steelworkers of America union employees of St. Joe Minerals began on April 1, 1984, at the five mines, when the workers' 3-year contract expired. The strike ended December 9, 1984, when agreement was reached on a contract that the company believed would permit St. Joe Minerals to remain competitive in the world lead market.

St. Joe Minerals had proven domestic reserves in Missouri of 57.3 million tons of ore grading about 5% lead at its fiscal yearend. Approximately 60% of the ore contained in its lead ore bodies was on properties held under Federal mineral leases for terms of 10 to 20 years, renewable for like terms. St. Joe Minerals pays the U.S. Bureau of Land Management a royalty of 5% of the gross value of produced concentrates from these ore bodies.

### Table 4.—Missouri: Tenor of lead ore milled and concentrates produced in 1984

| | | |
|---|---|---|
| Total material | metric tons | 4,748,910 |
| Metal content of ore:[1] | | |
| Copper | percent | 0.13 |
| Lead | do | 6.07 |
| Zinc | do | 1.13 |
| Concentrates produced and average content: | | |
| Copper | metric tons | 8,402 |
| Average copper content | percent | 28.67 |
| Lead | metric tons | 377,951 |
| Average lead content | percent | 75.83 |
| Zinc | metric tons | 84,101 |
| Average zinc content | percent | 58.15 |

[1] Figures represent metal content of crude ore only as contained in the concentrate.

### Table 5.—Production and value of lead in Missouri and the United States

| Year | Missouri | | | United States | |
|---|---|---|---|---|---|
| | Quantity (metric tons) | Value (thousands) | Percent of U.S. production | Quantity (metric tons) | Value (thousands) |
| 1980 | 497,170 | $465,393 | 90.3 | 550,366 | $515,189 |
| 1981 | 389,721 | 313,870 | 87.5 | 445,535 | 358,821 |
| 1982 | 474,460 | 267,150 | 92.6 | 512,516 | 288,579 |
| 1983 | 409,280 | 195,620 | 91.1 | [r]449,216 | [r]214,708 |
| 1984 | 278,329 | 156,766 | 86.5 | 321,897 | 181,305 |

[r] Revised.

Three lead smelters operated during the year. AMAX Lead operated the Buick smelter, annual capacity of 127,000 metric tons of pig lead, in western Iron County, for itself and its partner, Homestake; Asarco operated the Glover plant in southeastern Iron County, annual capacity of 100,000 metric tons; and St. Joe Lead operated the Herculaneum plant in Jefferson County, annual capacity of 204,000 metric tons.

The AMAX smelter-refinery produced 104,650 metric tons of refined lead from Buick Mine concentrates, down 19% from the record high set in 1983.[12] The decline was attributed to the strike at the mine during the second half of the year. The plant continued to operate under salaried technical and administrative personnel at one-third to three-quarters of capacity, but was closed completely from November 10 to yearend to replenish feedstocks. The refined lead was primarily used in manufacturing storage batteries.

Asarco temporarily suspended operations and laid off 113 employees at its Glover custom lead smelter and refinery on March 4, owing to low inventories of lead concentrates. The low concentrate inventories were a standing problem since the shutdown of Ozark Lead's Milliken Mine in March 1983. Glover, however, continued to ship refined lead from inventory and to receive lead concentrates, primarily from the Cominco American-Dresser Magmont Mine but supplemented by some foreign concentrates.

The Glover smelter was reopened May 7 and continued operating until the end of July. Glover celebrated producing its one-millionth ton of refined lead on May 31.

On November 26, a new contract with Asarco was ratified by the United Steelworkers of America. The settlement called for a 10-cent-per-hour cap on the cost-of-living adjustment (COLA), with a 35-cent maximum COLA increase over the life of the contract (to March 31, 1988), and significant reductions in medical benefits. These concessions on the part of workers resulted in significant reductions in labor costs. Until its West Fork Mine opens, Asarco must buy concentrates from outside firms.[13]

Despite the lengthy shutdowns, Glover produced 74,200 metric tons of refined lead, about 75% of capacity, and down about 19% from that of 1983, according to Asarco's annual report.

St. Joe Lead's lead smelter at Herculaneum, the Nation's largest, was operated by members of the Teamsters Union, and Herculaneum was unaffected by the United Steelworkers of America strike at the company's five captive mines, as long as the inventory of concentrates lasted. By early May, however, it became apparent that the stockpiled concentrates would provide feed only until May 18, at which date the smelter was officially shut for a 3-week vacation. After extended delays, it reopened in mid-September, and smelting and refining operations were resumed at the beginning of October at about one-half capacity. The second blast furnace was not restarted until after the December 9 mine strike settlement.

**Silver.**—Byproduct silver production from the lead-zinc mines declined nearly 31%, and value, nearly 51% from those of 1983. Average unit price for silver was $8.14 per troy ounce in 1984, compared with $11.45 in 1983. Silver was recovered from both lead and zinc concentrates from all seven of Missouri's Viburnum Trend mines and was also reported from copper concentrates produced at the Magmont Mine.

**Table 6.—Missouri: Mine production (recoverable) of gold, silver, copper, lead, and zinc**

| | | 1982 | 1983 | 1984 |
|---|---|---|---|---|
| Mines producing: Lode | | 8 | 8 | 7 |
| Material sold or treated: Lead ore | thousand metric tons | 8,531 | 7,303 | 4,749 |
| Production: | | | | |
| Quantity: | | | | |
| Silver | troy ounces | 2,241,159 | 2,021,343 | 1,401,070 |
| Copper | metric tons | 7,941 | 7,725 | 5,818 |
| Lead | do | 474,460 | 409,280 | 278,329 |
| Zinc | do | 63,680 | 57,044 | 45,458 |
| Value: | | | | |
| Silver | thousands | $17,817 | $23,124 | $11,406 |
| Copper | do | $12,745 | $13,033 | $8,575 |
| Lead | do | $267,150 | $195,620 | $156,766 |
| Zinc | do | $54,009 | $52,052 | $48,707 |
| Total[1] | do | $351,721 | $283,830 | $225,452 |

[1] Data may not add to totals shown because of independent rounding.

**Zinc.**—The output of zinc, a coproduct of lead at the mines, fell more than 20% from that of 1983, because of extended strikes at six mines, and was the lowest output recorded by the State since 1969. Total value decreased about 6%; however, the national average unit price for U.S. High Grade zinc was 48.60 cents per pound in 1984, compared with 41.39 cents in 1983.

Nationwide, zinc consumption had increased in 1983 and continued to do so for most end-use categories in 1984, partly because more zinc was used as a corrosion-inhibiting coating by the Nation's top four automakers.

In 1984, 1.36 million metric tons of ore grading 1.8% zinc was milled at AMAX's Buick facility, yielding 20,800 metric tons of zinc in concentrate. Output fell more than 8,700 tons from that of 1983, owing mainly to the strike. At yearend, ore reserves at the Buick Mine were 32.8 million tons, grading 1.4% zinc, down in grade 0.4% from that of 1983.

Asarco's West Fork mill was capable of processing 3,130 metric tons of ore per day and producing 6,800 tons of zinc in concentrate annually. Ore reserves were estimated to be 13.6 million tons, averaging 1.2% zinc.[14]

Cominco American was able to take advantage of higher zinc prices by increasing mining activity in the new Magmont West area, which contains higher-than-average zinc grades. According to Cominco American's annual report, the company milled more than 1 million tons of ore grading 2.1% zinc in 1984, compared with 1.4% in 1983, and produced a record high 30,000 tons of concentrate containing 18,000 tons of zinc. Ore reserves at yearend were 7.2 million tons averaging 1.2% zinc. Magmont was the only operating lead-zinc mine not struck during 1984.

St. Joe Minerals produced zinc in concentrates from all five Missouri mines; however, output fell about 38% from zinc production in 1983, according to Fluor's 1984 10K Annual Report. At capacity, St. Joe Minerals expected to produce 5,000 tons of zinc annually at the new Viburnum No. 35 operation.

St. Joe Resources Co. purchased National Zinc Co. for about $16.5 million in August and created a National Zinc Div. The acquisition created the country's largest zinc producing company, with annual capacity of 155,000 tons. The company's future plans for its plant in Bartlesville, OK, included treating excess zinc concentrates from its mines in Missouri and from three St. Joe Resources mines in South America.[15]

## NONMETALS

Gains were reported for virtually all facets of the industrial minerals industry in Missouri in 1984. Significant gains in the portland cement, crushed stone, and construction sand and gravel industries were due to increased construction activity in the State.

**Abrasive Materials (Tripoli).**—American Tripoli Co. produced finished tripoli at its Seneca, Newton County, plant. Raw material was mined from nearby deposits in Oklahoma. Tripoli is used as a mild abrasive, as a buffing and polishing compound, and as a filler and extender.

**Barite.**—The domestic barite industry experienced an upturn during the year, primarily owing to increased offshore drilling activity and a generally improved domestic economy. In Missouri, barite output increased significantly. Production data showed that increases in mine output could be attributed directly to lower rail rates and other improvements in transportation-related charges. Value per short ton, however, fell nearly 43% from that of 1983.

Three Washington County companies started up in January, shipping, on contract, from barite stockpiles. De Soto Mining Co. Inc. operated at 25% of capacity during the first half of the year, but, by yearend, total shipments from its stockpile at the Richwoods No. 1 Mine were nearly two-thirds greater than those of 1983.

General Barite Co. also shipped from stockpiles at its Old Mines pit and plant. NL Industries Inc.'s Baroid Div. produced all of the State's mine output from its Cadet Mine.

The principal use for barite was as a weighting agent in oil and gas well drilling muds. Chemicals, glass, and filler and extender uses accounted for minor amounts of barite.

**Cement.**—Portland cement production increased nearly 14% over that of 1983, but masonry cement production fell about 2%. The trend continued toward more foreign investment in the U.S. cement industry. Three of five portland cement plants in Missouri were wholly or partly owned by foreign firms: (1) Continental Cement Co. Inc., of Hannibal, 599,000 short tons clinker capacity (13% of Missouri's annual clinker capacity), partly owned by Cementa AB, Sweden; (2) Dundee Cement Co., wholly owned by Holderbank Financiere Glaris SA, Switzerland; and (3) River Cement Co., of Festus, wholly owned by Instituto Finanziario Industriale S.p.A., Italy.[16]

In an effort to combat heavy economic losses over the last 3 recession years, Dundee Cement, Clarksville, Pike County, proposed in early 1984 a $2 per hour decrease in hourly wages in an upcoming 3-year contract. Represented by Local 469 of the United Cement, Lime, Gypsum and Allied Workers Div. of the Boilermakers Union, employees, whose contract expired May 1, struck June 11, the first strike at the plant since it opened in 1967. Most of the company's employees joined the ranks of strikers, but by the end of the second week, the plant continued to produce and ship cement by using supervisory and salaried personnel.

Union workers returned to work on November 13 under terms of an implemented proposal, wherein union members would not receive a pay increase in the first year of the new 3-year pact, but would be granted a 35-cent-per-hour increase in the second year and a 30-cent-per-hour increase in the third year. Despite the strike, Dundee Cement produced nearly one-third of the State's portland cement output in 1984.

Average values of shipped portland cement and masonry cement in the State were $44.77 and $49.02, respectively, down $0.17 and $1.11 from those of 1983.

In decreasing order of quantity, finished portland cement was sold to ready-mixed concrete companies, concrete product manufacturers, highway contractors, building material dealers, miscellaneous customers, and other contractors.

About 97% of portland cement was transported in bulk by truck to the consumer; the remainder was shipped by barge.

**Table 7.—Missouri: Portland cement salient statistics**

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 5 | 5 |
| Production | 3,541,191 | 3,979,033 |
| Shipments from mills: | | |
| Quantity | 3,499,125 | 3,980,706 |
| Value | $157,248,651 | $178,225,067 |
| Stocks at mills, Dec. 31 | 444,227 | 384,212 |

**Table 8.—Missouri: Masonry cement salient statistics**

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 3 | 3 |
| Production | 136,557 | 142,664 |
| Shipments from mills: | | |
| Quantity | 146,398 | 143,455 |
| Value | $7,339,135 | $7,032,799 |
| Stocks at mills, Dec. 31 | 17,903 | 23,325 |

**Clays.**—Missouri ranked 10th in the Nation in clay and shale production. Total output increased more than 11%, and total value, nearly 21%, compared with 1983 figures. The State ranked first of 15 States that produced fire clay, accounting for 37% of the total national fire clay output, and fourth of 11 that produced fuller's earth. Quantities of common clay and shale and fire clay produced rose approximately 8% and 38%, respectively, and the quantity of kaolin produced decreased about 34% compared with 1983 figures.

The State's 20 companies operated 60 pits in 17 of its 114 counties: 47 pits produced fire clay; 10, common clay and shale; 2, fuller's earth; and 1, kaolin.

The six top-ranking companies each produced more than 100,000 short tons of clay and accounted for 77% of accumulated output and 82% of total value.

Average values per short ton ranged from $3.87 for common clay to $72.87 for fuller's earth, and averaged $16.57. Clays were used in portland cement, firebrick, pet waste absorbent, high alumina refractory specialties and grogs, face brick, aluminum sulfate production, pesticides and related products, flower pots, common face brick, and oil and grease absorbents. In addition, clay was used in expanded lightweight aggregates, which were used primarily in manufacturing concrete blocks, structural concrete items, and in highway surfacing.

Buildex Inc. of Ottawa, KS, a lightweight aggregate manufacturer, purchased the New Market (Platte County) lightweight aggregate plant from Carter-Waters Corp. of Kansas City. The transaction was completed in early 1984.

Kaiser Refractories & Chemical Corp. had fire clay manufacturing, research, and administrative facilities in Missouri as well as its 22 fire clay pits in Audrain, Callaway, Gasconade, and Montgomery Counties. At yearend 1984, employees were planning to purchase selected Kaiser Refractories plants through an Employee Stock Option Plan, or ESOP. The new firm, called National Refractory and Minerals Co., was to be headquartered in California.

**Table 9.—Missouri: Clays sold or used by producers**

(Thousand short tons and thousand dollars)

| Year | Fire clay | | Common clay | | Kaolin | | Total[1] | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value |
| 1980 | 700 | 12,808 | 1,041 | 2,540 | 77 | 1,451 | 1,817 | 16,798 |
| 1981 | 669 | 13,397 | 974 | 2,797 | 104 | 2,220 | 1,747 | 18,414 |
| 1982[2] | 448 | 8,833 | 851 | 2,605 | 84 | 1,971 | 1,383 | 13,409 |
| 1983[2] | 311 | 5,480 | 1,004 | 3,716 | 103 | 2,652 | 1,418 | 11,848 |
| 1984[2] | 428 | 8,540 | 1,079 | 4,179 | 68 | 1,947 | 1,575 | 14,666 |

[1] Data may not add to totals shown because of independent rounding.

[2] Excludes fuller's earth.

**Lime.**—Lime output from Missouri's three plants continued to increase moderately over that of the previous 2 years. Missouri ranked third of 38 lime producing States and was 1 of 6 States to produce more than 1 million short tons. Mississippi Lime Co. at Ste. Genevieve was the Nation's leading individual plant; its output of quicklime and hydrated lime was slightly more than that of 1983.

Resco Products of Missouri Inc. produced substantially more quicklime at its Bonne Terre plant in St. Francois County during 1984 than it did in 1983.

In 1984, 31% of the Nation's lime for water purification was produced in Missouri.

**Perlite (Expanded).**—No perlite ore was produced in the State. Brouk Co.—the larger of the two producing companies that expanded perlite from out-of-State sources—at its St. Louis plant in St. Louis County, and Georgia-Pacific Corp. at its Cuba plant, Crawford County, were Missouri's sole producers.

**Sand and Gravel.**—Compared with estimated output for 1983, Missouri produced about the same amount of both construction and industrial sands and gravels in 1984. Of Missouri's 114 counties, 50 produced construction sand and gravel, and 2, Jefferson and St. Louis Counties, also produced industrial sand and gravel.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

In 1984, 76 firms and highway departments produced construction sand and gravel from 115 pits; only 2 firms produced more than 1 million tons each.

Construction sand and gravel was used for asphaltic concrete aggregates, concrete aggregates, concrete products, fill, plaster and gunite sands, road base and coverings, road stabilization, snow and ice control, and miscellaneous uses. Use in concrete aggregates accounted for 28% of total volume. Average value per short ton ranged from $1.96 for miscellaneous uses to $3.38 for concrete aggregates.

Trucks transported 70% of the construction sand and gravel output from 105 of the 115 pits; the remainder was shipped by barge or other transportation or was not transported.

### Table 10.—Missouri: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 2,258 | $7,635 | $3.38 |
| Plaster and gunite sands | 71 | 223 | 3.14 |
| Concrete products | 127 | 364 | 2.86 |
| Asphaltic concrete | 311 | 770 | 2.48 |
| Road base and coverings[1] | 235 | 543 | 2.31 |
| Fill | 56 | 171 | 3.05 |
| Snow and ice control | 34 | 90 | 2.63 |
| Other[2] | 4,875 | 9,569 | 1.96 |
| Total or average | 7,967 | [3]19,364 | 2.43 |

[1] Includes road and other stabilization (cement).
[2] Includes other unspecified uses.
[3] Data do not add to total shown because of independent rounding.

*Industrial.*—Production from three pits amounted to 614,245 short tons of industrial sand, averaging $13.23 per short ton. Value ranged from $7.75 per ton for flux to $90.06 per ton for silica flour. The largest volume of industrial sand, 28%, was used in flat glass; other uses, among many, were in containers, foundry molding and core, and chemicals.

In late September 1983, Martin Marietta Corp. completed the sale of its Festus plant and nine other industrial sand plants in eight other States to Unimin Corp. of New Canaan, CT. Unimin was the main industrial sand supplier for the PPG Industries Inc. flat glass plant at Crystal City, Jefferson County. On December 7, 1984, PPG Industries closed the flat glass plant rather than spend $10 million to $20 million to repair the central float-glass production tank and to modernize the plant. About 350 workers were laid off; 150 of them would be able to apply for jobs at the firm's Mount Zion, IL, plant by the summer of 1985.

Pennsylvania Glass Sand Corp. planned to increase capacity for its ground silica product at its Pacific plant. Included in the project would be automated production and quality assurance equipment and automated packaging facilities.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—The Missouri Limestone Producers Association estimated that crushed stone output for aggregate increased by 15% to 20% during 1984. Increased demand was attributed to higher highway funding and lower interest rates.

Bussen Quarries nearly completed underground limestone mining at its Jefferson Barracks quarry in southeastern St. Louis County. Rental of the mined-out space for storage began in 1984; when the mine is fully developed, it is expected to have

1 million square feet of rentable space. The well-located site is accessible by rail, river, and highway transportation.

CMC Inc. mined and crushed gray marble from its underground mine at Carthage, Jasper County. In 1984, the mined out areas amounted to 1.6 million square feet, or about 37 acres, and was used for storage space. Much of the space was dehumidified and kept between 65° F and 70° F and leased to food product firms. Somewhat less space, 5,000 square feet, was devoted to cold storage, maintained at 38° F, and leased to a Colorado beer producer to store kegs and cases of the brew. The smallest amount of space was devoted to frozen goods kept at -10° F. The mined-out space also was used for offices and tennis courts.

The crushing facilities at the firm's Carthage site prepared marble for use by sugar refineries, sewage-filtration systems, ice control, concrete, asphalt, roofing, and ground cover. The finest grind calcium carbonate was sold for use in poultry grit, stock feed, agricultural lime, glassmaking, the manufacture of explosives, paper, synthetic flooring, paint, pharmaceuticals, and cosmetics.[17]

Missouri Limestone Co. also planned to enter the business of offering underground warehouse space for rent. In Warren County, the first phase of developing 250,000 square feet for refrigerated goods, to be completed the first part of 1985, was leased even before mining began.

Two portable primary crushers that use diesel and hydraulics as power sources have resulted in lower power costs and more efficient operations for Missouri Limestone, of Warrenton. The crushers have been moved to serve quarries as far away as Illinois and Kansas.[18]

Park Bend Quarries, Platte County, began operations in early 1984. The property was owned by Park College, Parkville, which was to receive a royalty on each ton of crushed stone produced. Plans called for using part of the underground mined-out space for the college library and, later, to use other space for maintenance facilities. Eventually, the college planned to develop space for commercial use and profit.

*Dimension.*—Dimension stone output was estimated to remain at the same level as that of 1983.

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[1] State Mineral Officer, Bureau of Mines, Denver, CO.

[2] Geologist, Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, MO.

[3] U.S. Bureau of the Census. Mineral Industries—Geographic Area Series, Missouri. 1982, table 2a, p. MO.-3.

[4] Engineering and Mining Journal. EPA Burdens U.S. Nonferrous Metals With Tighter Ruling. V. 185, No. 4, Apr. 1984, pp. 23-25.

[5] Taylor, H. Controls To Cut Worker Exposure to Lead at Four Asarco Plants Okayed. Am. Met. Mark., Feb. 1, 1984, p. 16.

[6] Independence Examiner. Council Member Takes Ride To Check Mine Limits. May 16, 1984, pp. 1, 14.
Rock Products. Quarry Subsidence Fears Alleviated. V. 87, No. 9, Sept. 1984, pp. 57-58.

[7] Data missing for some years.

[8] Spisak, J. F., H. D. Peterson, and G. E. Butts. Solvent Extraction of Cobalt From Nickel in Sulfate Leach Liquors. Miner. and Metall. Processing, v. 1, No. 1, May 1984, pp. 29-35.

[9] Wall Street Journal. AMAX Inc. Restructures Metals Group; Savings and Staff Cuts Seen. June 25, 1984, p. 49.

[10] ASARCO Incorporated. 1984 10K Annual Report.

[11] The Standard Oil Co. 1984 10K Annual Report. P. 10.

[12] AMAX Inc. 1984 10K Annual Report.

[13] American Metal Market. Mar. 7, 1985, p. 1.

[14] Work cited in footnote 10.

[15] American Mining Congress Journal. St. Joe To Buy National Zinc. V. 70, No. 17, Aug. 29, 1984, p. 13.

[16] Rock Products. Trends. V. 87, No. 11, Nov. 1984, pp. 28-32.

[17] Fairbanks, M. Moving Marble. Columbia Missourian, Aug. 5, 1984, pp. 3-8.

[18] Robertson, J. L. Portable Plants Cut Power Charge. Rock Prod., v. 87, No. 3, Mar. 1984, pp. 46-48.

### Table 11.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Barite: | | | |
| NL Industries Inc., Baroid Div | Box 2808<br>St. Louis, MO 63111 | Mines and plant | Washington. |
| Cement: | | | |
| Dundee Cement Co.[1] [2] | Box 67<br>Clarksville, MO 63336 | Quarry and plant | Pike. |
| Lone Star Industries Inc.[3] | One Greenwich Plaza<br>Box 5050<br>Greenwich, CT 06836 | Quarries and plants | Cape Girardeau,<br>Jackson,<br>St. Louis. |
| Missouri Portland Cement Co | 7711 Carondelet Ave.<br>St. Louis, MO 63105 | do | Jackson. |
| River Cement Co., a subsidiary of IFI International of Italy (Instituto Finanziario Industriale S.p.A.).[4] | Box 14545<br>St. Louis, MO 63178 | Quarry and plant | Jefferson. |
| Clays: | | | |
| Dillon Clay Mining Co | Box 115<br>St. James, MO 65559 | Pits | Crawford. |
| A. P. Green Refractories Co., a subsidiary of United States Gypsum Co. | 1018 East Breckenridge St.<br>Mexico, MO 65265 | Mines | Audrain,<br>Callaway,<br>Gasconade,<br>Maries,<br>Osage. |

See footnotes at end of table.

## Table 11.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays —Continued | | | |
| Kaiser Aluminum & Chemical Corp | Box 499<br>Mexico, MO 65265 | Mines and plants | Audrain, Callaway, Gasconade, Montgomery. |
| Lehigh Portland Cement Co. (Continental Cement Co.). | Box 13128<br>Port Everglades<br>Fort Lauderdale, FL 33316 | Mine | Ralls. |
| Southern Clay Inc. (Lowe's Inc.) | Box 1086<br>Cape Girardeau, MO, 63701 | Pits and plants | Stoddard. |
| Iron: | | | |
| Pea Ridge Iron Ore Co., a subsidiary of St. Joe Minerals Corp. | Route 4<br>Sullivan, MO 63080 | Underground mine and plant. | Washington. |
| Lead: | | | |
| AMAX Lead Co. of Missouri and Homestake Mining Co.[5] | Boss, MO 65440 | do | Iron. |
| Cominco American Incorporated[5] | Bixby, MO 65439 | do | Do. |
| St. Joe Lead Co., a division of St. Joe Minerals Corp., a subsidiary of Fluor Corp.[5] [6] | Box 500<br>Viburnum, MO 65566 | Underground mines and plants. | Iron, Reynolds, Washington. |
| Lime: | | | |
| Ash Grove Cement Co.[7] | 8900 Indian Creek Parkway<br>Suite 600<br>Overland Park, KS 66225 | Plant | Greene. |
| Mississippi Lime Co | 7 Alby St.<br>Alton, IL 62002 | Quarry and plant | Ste. Genevieve. |
| Resco Products of Missouri Inc., Bonne Terre Limekiln. | Box 1110<br>Bonne Terre, MO 63628 | Plant | St. Francois. |
| Perlite (expanded): | | | |
| Brouk Co | 1367 South Kingshighway Blvd.<br>St. Louis, MO 63110 | do | St. Louis. |
| Sand and gravel: | | | |
| Construction: | | | |
| Holiday Sand & Gravel Co., a subsidiary of List & Clark Construction Co. | 6811 West 63d. St.<br>Overland Park, KS 66204 | Dredges and plants | Buchanan and Clay. |
| Limited Leasing Co., a subsidiary of St. Charles Sand Co. | Route 1, Box 158<br>Hazelwood, MO 63042 | do | St. Louis and St. Louis City. |
| Missouri Gravel Co., a subsidiary of Moline Consumers Co. | 313 16th St.<br>Moline, IL 61265 | Pits and plants | Lewis and St. Louis. |
| Winters Bros. Material Co | 13098 Gravois Rd.<br>St. Louis, MO 63127 | Dredge and plant | St. Louis. |
| Industrial: | | | |
| Master Bros. Silica Sand Co | Route 1, Box 204<br>Pevely, MO 63070 | do | Jefferson. |
| Pennsylvania Glass Sand Corp | Box 187<br>Berkeley Springs, WV 25411 | do | St. Charles and St. Louis. |
| Unimin Corp | 258 Elm St.<br>New Canaan, CT 06840 | Mine and plant | Jefferson. |
| Stone: | | | |
| Missouri Pacific Corp | Box 307<br>Piedmont, MO 63959 | Quarry | Wayne. |
| Moline Consumers Co | 313 16th St.<br>Moline, IL 61265 | Quarries | Jefferson, Knox, Lewis, Marion, Monroe, Pike, Ralls, St. Louis, Shelby. |
| Tower Rock Stone Co | Box 69<br>Columbia, IL 62236 | Quarry | Ste. Genevieve. |
| Fred Weber Inc | 7929 Alabama Ave.<br>St. Louis, MO 63111 | Quarries | Jefferson, St. Charles, St. Louis. |
| West Lake Quarry & Material Co | 13570 St. Charles Rock Rd.<br>Bridgeton, MO 63044 | do | Cape Girardeau, Jefferson, St. Louis, Scott. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 62 Whittemore Ave.<br>Cambridge, MA 02140 | Plant | St. Louis. |

[1] Also clays in Pike County.
[2] Also stone in Pike County.
[3] Also stone in Cape Girardeau County.
[4] Also stone in Jefferson County.
[5] Also silver, copper, and zinc.
[6] Also stone in St. Francois County.
[7] Also stone in Bates, Dallas, Greene, Hickory, Polk, and Vernon Counties.

# The Mineral Industry of Montana

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Montana Bureau of Mines and Geology for collecting information on all nonfuel minerals.**

**By W. L. Rice,[1] Henry G. McClernan,[2] and D. C. Lawson[3]**

Montana's nonfuel mineral production value dropped in 1984 to $249 million, a 15% decrease from the $292 million recorded in 1983. An increase in gold production, a stability in the amount of silver produced, and an increase in industrial mineral production value were insufficient to offset depressed precious and base metals prices, a cessation of molybdenum production, and a substantial reduction in the production of copper.

Gold was the leading commodity in terms of value, followed by silver, copper, and portland cement. The metals—copper, gold, iron, lead, and silver—accounted for 58% of the total nonfuel mineral value for the year, compared with 64% of the total value in 1982, and 65% in 1983.

**Table 1.—Nonfuel mineral production in Montana[1]**

| Mineral | | 1983 | | 1984 | |
|---|---|---|---|---|---|
| | | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Antimony | short tons | 253 | W | -- | -- |
| Barite | thousand short tons | 10 | $750 | W | W |
| Clays | do | 194 | 6,205 | 397 | $15,260 |
| Copper (recoverable content of ores, etc.) | metric tons | 33,337 | 56,245 | W | W |
| Gem stones | | NA | 300 | NA | 450 |
| Gold (recoverable content of ores, etc.) | troy ounces | 161,436 | 68,449 | 181,190 | 65,348 |
| Lead (recoverable content of ores, etc.) | metric tons | 1,163 | 556 | W | W |
| Lime | thousand short tons | 86 | W | 89 | 5,097 |
| Sand and gravel (construction) | do | [e]5,000 | [e]10,200 | 7,776 | 21,269 |
| Silver (recoverable content of ores, etc.) | thousand troy ounces | 5,708 | 65,299 | 5,653 | 46,018 |
| Stone (crushed) | thousand short tons | 872 | [r]2,320 | [e]950 | [e]2,400 |
| Combined value of cement, graphite, gypsum, iron ore, molybdenum (1983), peat, phosphate rock, sand and gravel (industrial), stone (dimension), talc, vermiculite, and values indicated by symbol W | | XX | [r]81,644 | XX | 93,521 |
| Total | | XX | [r]291,968 | XX | 249,363 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Montana, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Beaverhead | $427 | W | Silver, stone (crushed), gold, lead, copper. |
| Big Horn | -- | (2) | |
| Broadwater | 490 | W | Lime, gold, silver, graphite, lead, copper. |
| Carbon | W | W | Clays. |
| Carter | W | W | Do. |
| Cascade | 1,714 | W | Silver, stone (crushed), gold, lead, copper. |
| Custer | 1 | (2) | |
| Dawson | 494 | (2) | |
| Deer Lodge | 209 | W | Clays. |
| Fergus | W | W | Gypsum. |
| Flathead | 2,970 | (2) | |
| Gallatin | W | W | Cement, stone (crushed), clays. |
| Granite | 9,580 | W | Silver, gold, copper, lead. |
| Hill | W | (2) | |
| Jefferson | 14,178 | W | Gold, cement, stone (crushed), silver, lead, clays, copper. |
| Judith Basin | W | W | Gypsum. |
| Lake | W | $60 | Peat. |
| Lewis and Clark | 531 | W | Gold, silver, copper, lead. |
| Liberty | W | (2) | |
| Lincoln | 77,444 | 86,640 | Silver, copper, vermiculite, lead, gold. |
| Madison | 8,529 | W | Talc, gold, silver, copper, lead. |
| Meagher | W | W | Iron ore, stone (crushed), gold. |
| Mineral | 29 | (2) | |
| Missoula | W | 750 | Barite. |
| Musselshell | 45 | (2) | |
| Park | W | 185 | Stone (dimension), stone (crushed), sand and gravel (industrial). |
| Petroleum | 44 | (2) | |
| Phillips | 27,350 | W | Gold, silver, copper, lead. |
| Pondera | 22 | (2) | |
| Powell | W | W | Phosphate rock, gold, silver, lead, copper. |
| Ravalli | W | W | Peat. |
| Richland | 1,564 | 1,475 | Lime. |
| Rosebud | W | (2) | |
| Sanders | W | W | Antimony. |
| Sheridan | 62 | (2) | |
| Silver Bow | W | W | Copper, molybdenum, silver, gold, lead. |
| Stillwater | (3) | -- | |
| Toole | 159 | (2) | |
| Valley | W | W | Clays. |
| Wibaux | 8 | (2) | |
| Yellowstone | W | W | Lime. |
| Undistributed[4] | [r]120,187 | 192,660 | |
| Sand and gravel (construction) | XX | [e]10,200 | |
| Stone: | | | |
| Crushed | [e]4,700 | XX | |
| Dimension | W | XX | |
| Total[5] | [r]270,731 | 291,968 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Crushed stone was produced; data not available by county. Total State value is shown separately under "Stone: Crushed."

[4] Includes gem stones and some stone production that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to totals shown because of independent rounding.

## Table 3.—Indicators of Montana business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 805 | 815 | 824 |
| Total civilian labor force | do | 393 | 396 | 405 |
| Unemployment | do | 34 | 35 | 30 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 9.3 | 7.4 | 7.5 |
| Metal mining[2] | do | 1.7 | 1.5 | NA |
| Nonmetallic minerals except fuels[2] | do | .9 | .9 | NA |
| Coal mining[2] | do | 1.3 | 1.3 | NA |
| Oil and gas extraction[2] | do | 5.5 | 3.7 | NA |
| Manufacturing total | do | 20.6 | 22.1 | 22.3 |
| Primary metal industries[2] | do | 1.4 | 1.2 | NA |
| Stone, clay, and glass products[2] | do | 1.1 | 1.1 | NA |
| Chemicals and allied products[2] | do | .5 | .5 | NA |
| Petroleum and coal products[2] | do | 1.0 | 1.0 | NA |
| Construction | do | 13.4 | 13.3 | 12.6 |
| Transportation and public utilities | do | 22.0 | 20.4 | 20.5 |
| Wholesale and retail trade | do | 71.9 | 73.6 | 76.4 |
| Finance, insurance, real estate | do | 12.8 | 13.0 | 13.4 |
| Services | do | 56.3 | 57.8 | 59.8 |
| Government and government enterprises | do | 67.4 | 68.4 | 68.3 |
| Total | do | 273.7 | 276.0 | [3]280.9 |
| Personal income: | | | | |
| Total | millions | $7,790 | $8,196 | $8,690 |
| Per capita | | $9,679 | $10,050 | $10,546 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.3 | 39.7 | 39.1 |
| Mining | | 41.9 | 41.3 | 39.4 |
| Total average hourly earnings, production workers | | $9.86 | $10.44 | $10.74 |
| Mining | | $12.54 | $12.94 | $12.80 |
| Earnings by industry: | | | | |
| Farm income | millions | $585 | $151 | $795 |
| Nonfarm | do | $36,515 | $39,502 | $43,722 |
| Mining total | do | $201 | $187 | $195 |
| Metal mining | do | $72 | $66 | $54 |
| Nonmetallic minerals except fuels | do | $53 | $52 | $61 |
| Coal mining | do | $63 | $61 | $72 |
| Oil and gas extraction | do | $13 | $7 | $8 |
| Manufacturing total | do | $9,199 | $9,829 | $11,136 |
| Primary metal industries | do | $388 | $369 | $422 |
| Stone, clay, and glass products | do | $248 | $267 | $293 |
| Chemicals and allied products | do | $851 | $901 | $983 |
| Petroleum and coal products | do | $45 | W | W |
| Construction | do | $1,899 | $2,083 | $2,476 |
| Transportation and public utilities | do | $3,845 | $4,178 | $4,454 |
| Wholesale and retail trade | do | $6,589 | $6,830 | $7,531 |
| Finance, insurance, real estate | do | $2,075 | $2,398 | $2,643 |
| Services | do | $7,144 | $7,962 | $8,833 |
| Government and government enterprises | do | $5,459 | $5,922 | $6,329 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 2,052 | 3,057 | 2,654 |
| Value of nonresidential construction | millions | $121.6 | $130.0 | $121.1 |
| Value of State road contract awards | do | $79.4 | $144.5 | $143.9 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 229 | 266 | 254 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $270.7 | $292.0 | $249.4 |
| Value per capita | | $336 | $358 | $303 |

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

The impact of the June 1983 suspension of The Anaconda Minerals Co.'s Butte copper operations continued to be felt in 1984; the State's copper production suffered a significant drop, and no molybdenum was produced during the year. Anaconda Minerals sold a large part of the open pit mining equipment it used when the Berkeley Pit was in full production and was concluding a small-scale drilling program to refine its knowledge of the district. Hopes for an early resumption of mining, bolstered by favorable union work rule changes, faded by yearend as copper prices remained at a depressed level.

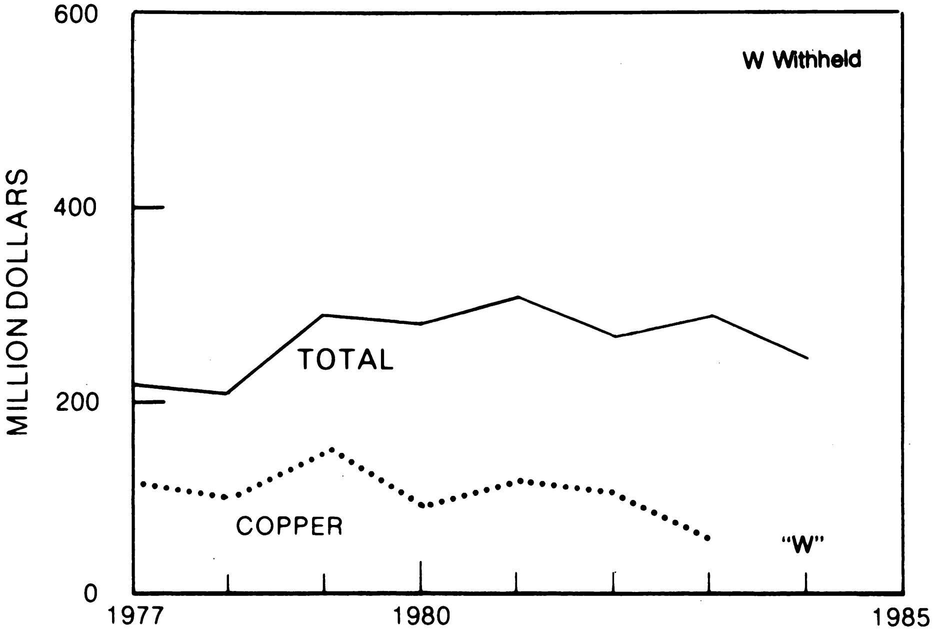

Figure 1.—Value of copper and total value of nonfuel mineral production in Montana.

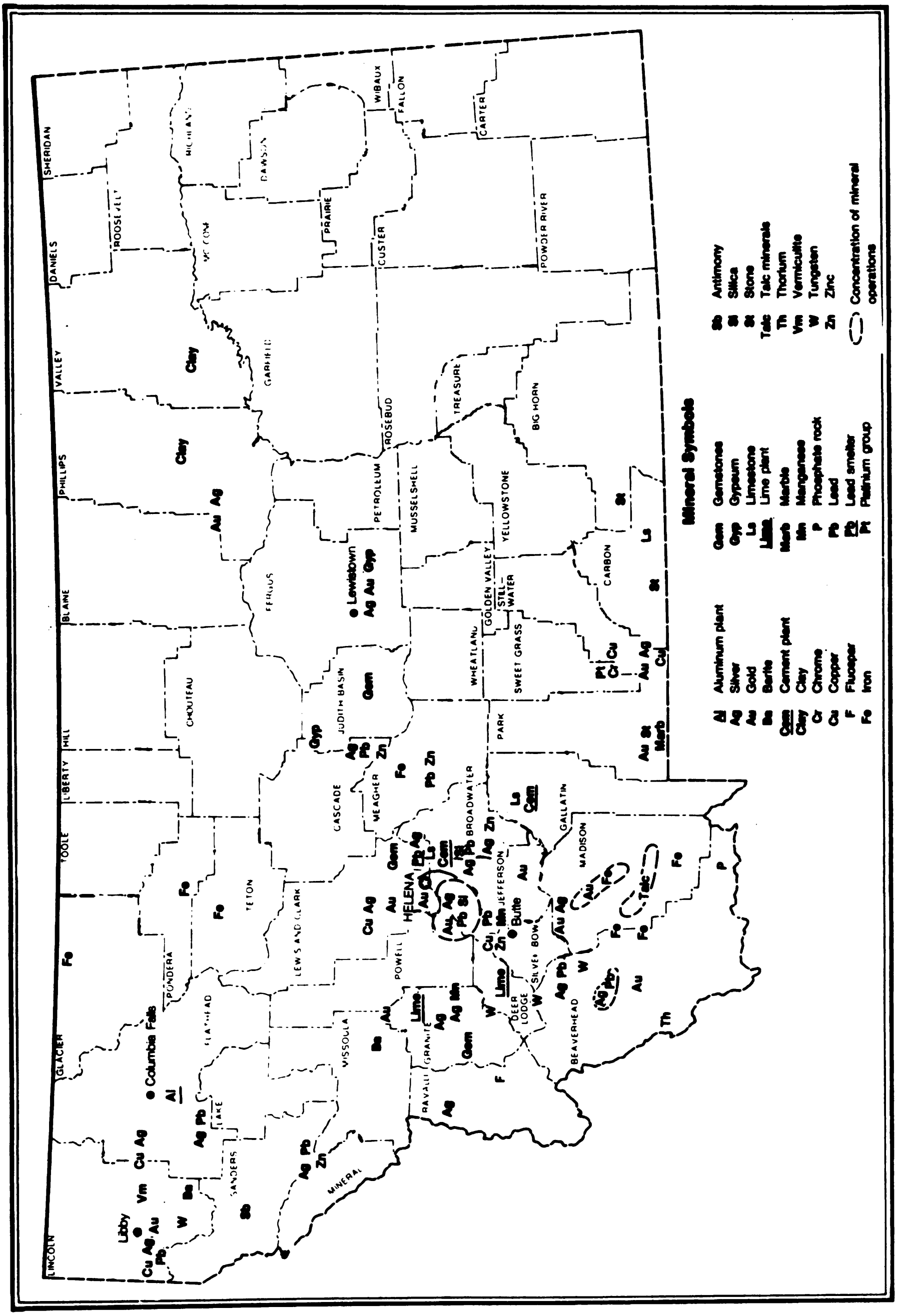

Figure 2.—Principal mineral producing localities in Montana.

**Employment.**—Overall mining employment in Montana for 1984 was 7,500, slightly more than the number reported for 1983. Average weekly earnings for mineral industry production workers was $419.93; it was the second highest in the State, next to wages paid to construction workers. This figure represented a decrease of $30.10 per week from that of 1983.

**Exploration Activities.**—The level of exploration activity in Montana, largely for precious metals, was up slightly from that of 1983. The number of exploration licenses granted by the Department of State Lands increased from 201 granted to 75 companies in 1983 to 215 licenses issued to 91 companies in 1984. The number of new mining claims filed in 1984 with the U.S. Bureau of Land Management (BLM) in Montana was down about 30% from that for 1983, and the number of small mine exclusion permits issued by the State decreased in 1984 from the 1983 level.

ASARCO Incorporated and United States Borax & Chemical Corp. continued exploration for stratabound silver-copper deposits in and adjoining the Cabinet Mountains Wilderness in Lincoln County. Asarco submitted a plan of operations to permitting agencies at midyear and did baseline studies for an environmental impact statement; U.S. Borax drilled on claims outside the wilderness area boundary.

Drilling to firm up reserves continued in 1984 on the Centennial Minerals Ltd.-U.S. Minerals Exploration Co. joint venture Montana Tunnels gold-silver project near Wickes, Jefferson County. An engineering feasibility study conducted during the year recommended the deposit be developed as a 15,000-short-ton-per-day open pit mine using conventional flotation-cyanide processing methods.

Aries Resources began work in August on a 2-year silver exploration project just west of Butte in Silver Bow County. The 1,705-acre area, owned by Anaconda Minerals, contains up to 30 mineralized veins that have values in gold, silver, zinc, lead, and manganese. Lee Mining Corp. completed drilling by midyear on an area north and west of Walkerville as part of a silver exploration project. Lee also conducted preliminary exploration at the Southern Cross Mine near Anaconda. Dragon Energy Corp. completed a percussion drilling program on its 54-claim group 12 miles southwest of Butte; the company reported that significant gold mineralization was indicated.

AMAX Exploration Inc. participated with Gulf Titanium Ltd. in an exploration project at the Cruse-Belmont Mines near Marysville, Lewis and Clark County. The Goldsil Mining and Milling Co.-Consolidated Paymaster Resources Ltd. joint venture completed three drill holes on the 400 level of the Drumlummon Mine at Marysville; one hole intersected 14 feet of vein with an 8-foot section assaying 0.44 troy ounce of gold and 1.0 troy ounce of silver per ton. Big Horn Minerals Corp. continued exploration drilling at its Scratchgravel gold prospect near Helena; several drill intercepts with significant gold assays were reported from relatively shallow depths. Property in and near Rimini in Lewis and Clark County was drilled by Century Silver Mines Inc.; 6 feet of massive sulfides bearing silver, lead, copper, and zinc was encountered in the second hole.

Cominco American Incorporated's exploration project in the Smith River Valley near White Sulphur Springs was continued during the year, and Cominco also drilled on the Gold Eagle Mining Co. Inc.'s High Tariff property in the Neihart district.

Beralynn Resources Inc. drilled several targets on its Goldstar gold property in the Silver Star district in Madison County. Gold occurrences on the Plymouth, Three Forks, and Klondyke properties in the Elkhorn district, Jefferson County, were explored by Mountain West Resources.

**Legislation and Government Programs.**—Work progressed on the Montana Bureau of Mines and Geology (MBMG)-U.S. Geological Survey (USGS) cooperative effort to produce Conterminous United States Mineral Appraisal Program (CUSMAP) 2° geologic maps for incorporation into Montana's Atlas Series. The Wallace sheet was well on the way to completion by yearend, and progress was made on the Kalispell, Hamilton, Butte, Dillon, Wolf Point, Jordan, Glendive, Forsyth, and Miles City 2° maps.

Major current MBMG projects include a compilation and review of Montana barite deposits, regional analysis of favorable geologic environments for stratabound and stratiform precious and base metals ore deposits, and a regional appraisal of economic mineral potential in the Belt 1:100,000-scale quadrangle in central Montana. The MBMG released 11 formal publications and placed 34 titles on open-file in 1984, and the ongoing MBMG-USGS hydrologic cooperative program worked on 7 projects during the year.

The Mining and Mineral Resources Research Institute of the Montana College of Mineral Science and Technology at Butte received an allotment from the U.S. Bureau of Mines in 1984.

Montana received $22.9 million in 1984 from the BLM as receipts from the Mineral Leasing Act.

Mineral taxes collected by the State on nonfuel minerals, coal, oil, and natural gas amounted to $148 million in fiscal year 1984; mineral taxes represented 27.6% of the total Montana Department of Revenue collections for the year.

Montana's congressional delegation introduced joint legislation in 1984 to add 747,178 acres of land to the State's wilderness areas. In addition, 507,232 acres was proposed for scenic, wildlife, or recreational use, and 5 million acres would be released for multiple purpose uses under U.S. Forest Service management. The proposed bill, which would have brought Montana's total wilderness area up to 4,107,639 acres, was not enacted by Congress.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

**Aluminum.**—Primary aluminum production in Montana increased 65% in quantity and 88% in value over that of 1983. Reflecting the mid-1983 economic recovery, ARCO Aluminum Co.'s reduction plant at Columbia Falls, Flathead County, operated at the highest production level since 1981. Despite a worldwide aluminum oversupply, which led to a 68% drop in aluminum prices by midyear, and despite increased electric power rates, the Columbia Falls smelter finished the year operating at 100% of rated capacity.

**Copper.**—Copper production was reported from 6 mines and 1 leaching operation in 5 counties in 1984, compared with output from 19 mines in 11 counties in 1983. Montana's copper production ranked fourth in the Nation.

The State's three top-ranked producers were Asarco's Troy silver-copper mine in Lincoln County, Anaconda Minerals from leaching operations at Butte, and Black Pine Mining Co.'s Black Pine Mine near Philipsburg in Granite County. Montana's copper production was down significantly from that of 1983.

**Gold.**—Gold production was reported from 14 lode mines in 7 counties in 1984, compared with production from 24 mines in 10 counties in 1983. Two placer operations reported production, and gold was recovered from retreatment of old mine tailings. Montana's gold production ranked fourth in the Nation, accounting for nearly 9% of the national total in 1984. The State's 1984 gold production was up 12% in quantity from that of 1983, but value decreased by 5%.

Placer U.S. Inc. increased production at its Golden Sunlight Mine near Whitehall, Jefferson County. Production increased from nearly 80,000 troy ounces in 1983 to about 97,000 ounces in 1984, and mill throughput increased from 1.6 million short tons in 1983 to almost 1.9 million tons in 1984. Mine development at the Mineral Hill open pit continued throughout the year, and progress was made on studies to develop the mine's deep West Mineral Hill zone. The Golden Sunlight Mine was Montana's first-ranked gold producer in 1984, accounting for nearly 54% of the State's production.

Pegasus Gold Inc. (formerly Pegasus Gold Ltd.) continued to produce gold and silver from its Zortman and Landusky open pit mines and heap leach facility in the Little Rockies district in Phillips County. The operation, which is constrained to 7 or 8 months per year because of severe winter weather conditions, added 5.7 million tons of ore to the leach pads in 1984, bringing the total amount of ore placed on the pads to 17.9 million tons. The construction of large-scale leach pads was initiated in 1984, and a rigorous grade control program, which contributed to a lower waste-to-ore ratio, was implemented during the year. Exploration and development work and the acquisition of adjacent property increased ore reserves at the Zortman-Landusky operations from 22.7 to 43 million tons by yearend. The Pegasus operations ranked second in the State in gold production for 1984.

Pegasus Gold Inc. was formed as a new company by the merger in August of Pegasus Gold Ltd. and Montoro Gold Inc. The company completed approximately 10,000 feet of drilling to further delineate reserves at Montoro's Beal property at German Gulch, southwest of Butte in Silver Bow County.

The Homestake Mining Co.-American Copper & Nickel Co. Inc. (a subsidiary of Inco Ltd.) joint venture continued development work on its Jardine gold mine north of Gardiner, Park County. The proposed 750-ton-per-day mine would have a 20-year mine life. Formal application for operating permits was made in August; if permits are granted, mine construction is projected to begin in the spring of 1986, followed by production in 1987.

The Golden Maple Mining and Leaching Co. operated its Gilt Edge open pit mine and leach plant near Lewistown in Fergus County; the first gold doré bar was poured in September from ore previously mined. The company planned to mine and commence leaching on 150,000 tons of ore in 1984. Pilot mining and leaching operations were carried out at the North Moccasin Mine by Canadian Minerals Inc.; the mine is about 15 miles northwest of Lewistown. Triad Investments Inc., operator of the Judith gold property at Kendall in Fergus County, did additional development drilling north and south of the Muleshoe Claims and commenced heap-leaching operations.

**Lead.**—Lead was recovered as a byproduct from six precious and base metals mines in four counties, and from reprocessing old tailings. Montana ranked fifth in the Nation for lead production in 1984; the State's lead production decreased 18% from the 1983 level.

Asarco's East Helena smelter, the only remaining lead smelter in the Northwestern United States, operated at capacity throughout the year. Feedstocks were predominantly purchased and custom toll concentrates from both domestic and foreign sources; bullion was shipped to Asarco's Omaha, NE, refinery. The zinc fuming plant placed on standby in 1982 did not operate in 1983 and 1984.

**Platinum-Palladium.**—Stillwater Mining Co., a joint venture between Manville Products Corp., Chevron Resources Inc., and Anaconda Minerals, completed a bulk sampling program and continued a feasibility study during 1984. The proposed 1,000-ton-per-day mine in the Stillwater Complex near Nye, Stillwater County, would produce about 350,000 to 360,000 troy ounces of palladium per year; the ratio of palladium to platinum in the ore would be about 3.1 to 1. A production decision is expected in 1986.

**Silver.**—Although the quantity of silver produced in Montana in 1984 was nearly the same as that credited for 1983, depressed silver prices caused a 30% drop in production value from the 1983 level. The State again produced nearly 13% of the Nation's silver in 1984; however, it dropped to third ranking in total silver production. In 1984, silver production was reported from 14 mines in 8 counties and from retreatment of old tailings, compared with production from 28 mines in 12 counties during 1983.

Asarco's Troy Mine in Lincoln County was again Montana's top silver producer, accounting for nearly 76% of the State total; the Troy Mine also was the third-ranked producer in the Nation for 1984. Black Pine Mining's Black Pine Mine in Granite County was the State's second largest silver producer; ore from the Black Pine Mine was beneficiated by Contact Mining Co. in its 1,200-ton-per-day mill at Philipsburg in Granite County. Contact Mining continued work on reopening the Granite-Bimetallic Mine in the Philipsburg district. Byproduct silver reported by Pegasus Gold Inc. from its Zortman-Landusky gold operation in Phillips County gave that company third ranking in 1984 silver production for the State.

CoCa Mines Inc. indefinitely deferred mine development and reopening of its silver deposits in the Hog Heaven district, Flathead County. The company had finished exploration on an open pit minable ore body and on a mineralized zone to be developed for underground mining. Mine development and reclamation plans had been approved by the State, a $350,000 reclamation bond had been posted, and construction was to have begun in the fall of 1984.

Asarco submitted a plan of operations to the U.S. Forest Service and to the State for its proposed Rock Creek silver-copper mine in the Cabinet Mountains Wilderness area, Sanders County. Ore reserves estimated at 143.7 million tons would be mined by room and pillar methods through double, 2-mile-long adits with portals over 1 mile outside the wilderness boundary. Ore would be transported by conveyor from an underground crusher to a surface mill complex. The mine would produce at a rate of 10,000 tons per day, with an estimated annual production of 5.3 million ounces of silver and 21,800 tons of copper; mine life was estimated at 29 years.

**Table 4.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by class of ore or other source material**

| Source | Number of mines[1] | Material sold or treated[2] (metric tons) | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|---|---|
| Lode ore: | | | | | | | |
| Dry gold[3] | 8 | W | W | 170,149 | -- | W | -- |
| Gold-silver | 3 | 1,138 | 374 | W | W | W | -- |
| Silver | 4 | W | W | W | W | W | -- |
| Total | 15 | W | W | W | W | W | -- |
| Copper[3] | 1 | W | -- | -- | W | -- | -- |
| Other lode material: | | | | | | | |
| Gold tailings | 1 | W | W | W | -- | -- | -- |
| Gold-silver tailings | 1 | W | W | W | -- | W | -- |
| Total lode | 16 | W | W | [4]5,652,847 | W | W | -- |
| Placer | 2 | -- | W | -- | -- | -- | -- |
| Grand total | 18 | [4]10,034,174 | [4]181,190 | 5,652,847 | W | W | -- |

W Withheld to avoid disclosing company proprietary data.

[1] Details may not add to total because some mines produce more than one class of material. Operations from which metals were recovered only from tailings are not counted as producing mines.

[2] Does not include gravel washed.

[3] Includes material that was leached.

[4] Includes items indicated by symbol W.

**Table 5.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in Silver Bow County**

| Year | Mines producing | Material sold or treated (thousand metric tons) | Gold (troy ounces) | Silver (thousand troy ounces) |
|---|---|---|---|---|
| 1980 | 1 | 8,244 | 11,541 | 1,596 |
| 1981 | 1 | 13,729 | 14,394 | 2,028 |
| 1982 | 1 | 12,847 | 3,361 | 739 |
| 1983 | 1 | 6,287 | 1,383 | 313 |
| 1984 | 3 | W | W | W |
| 1882-1984 | -- | W | W | W |

| Year | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) | Total value[1] (thousands) |
|---|---|---|---|---|
| 1980 | 37,467 | -- | -- | $124,602 |
| 1981 | 59,477 | -- | -- | 139,555 |
| 1982 | 48,144 | -- | -- | 84,410 |
| 1983 | 18,694 | 111 | -- | 35,761 |
| 1984 | W | -- | -- | W |
| 1882-1984 | W | W | W | W |

W Withheld to avoid disclosing company proprietary data.

[1] Derived from average values of the metals; includes average value of copper produced in wire bars prior to 1982 and average value of copper produced in cathodes for 1982, 1983, and 1984.

## NONMETALS

**Barite.**—Montana Barite Co. Inc., a subsidiary of NICOR Mineral Ventures, operated barite mines at Elk Creek and Coloma in the Garnet Range and started mining at the Kenelty deposit east of Libby in Lincoln County. Barite was processed at the company's mill in Missoula.

**Cement.**—The amount of cement produced in Montana in 1984 increased about 3% over that of 1983, but the continued low level of construction activity precluded any significant change in production. Portland and masonry cements were produced by Kaiser Cement Corp. at Montana City in Jefferson County and by Ideal Basic Industries Inc. at Trident, Gallatin County. Portland cement produced in the State was used by ready-mixed concrete companies (67%); other contractors (20%); concrete products manufacturers (6%); and building material dealers, highway contractors, government agencies, and miscellaneous customers (7%). Raw materials consumed in cement manufacture were limestone, clays, sandstone, sand, iron ore, gypsum, slag, and other additives. Shipments to consumers were mostly by truck and rail.

**Clays.**—Montana moved up to second ranking in bentonite production for 1984; production doubled in quantity and was nearly 2-1/2 times greater in value than that reported for 1983. Bentonite was produced by 4 companies from 16 deposits in Carbon, Carter, and Valley Counties.

American Colloid Co. processed previously mined and stockpiled bentonite at its plant in Malta. Aurora Industries Inc.'s Federal Bentonite Div. mined and field-dried bentonite from its Glasgow deposit; the partially dried material was shipped to Federal Bentonite Div.'s Burnett, MN, plant for further processing and sale to the taconite industry. In April, Aurora signed a letter of intent with IMCO Services of Dallas, TX, a Halliburton Co. subsidiary, to purchase Aurora's Federal Bentonite Div.

A large share of Montana's bentonite was sold for drilling mud, iron ore pellet binder, and foundry sand.

Common clay, produced by four companies from five pits in Gallatin and Jefferson Counties, was used in portland cement, concrete blocks, and in pottery.

**Gem Stones.**—Montana ranked fourth in the Nation in gem stone production in 1984. Intergem Inc. continued to mine commercial quantities of corundum gem stones, including blue sapphires, from its Yogo Gulch deposit in the Little Belt Mountains, Fergus County. Sapphire-bearing dike rock is surface mined, allowed to weather for 3 years, and processed by gravity methods to recover the sapphires.

**Graphite.**—Montana remained the Nation's only producing State for natural amorphous graphite in 1984. Production by National Minerals Corp. in Broadwater County decreased about 50% in quantity and value from that reported in 1983.

**Gypsum.**—Gypsum production in Montana increased nearly 19% in quantity and 16% in value over that reported for 1983. A limited recovery in building construction, with a resulting improvement in the wallboard industry, accounted for the increase.

United States Gypsum Co. mined gypsum from its underground Shoemaker Mine at Heath in Fergus County; the gypsum was used in the company's wallboard plant. Maronick Construction Co. Inc. reclaimed two open pit mines at Raynesford, Judith Basin County, and shipped gypsum to the Kaiser Cement plant at Montana City and to the Ideal Basic Industries cement plant at Trident.

**Lime.**—The quantity of lime produced in the State increased about 3% and the value nearly 16% over that recorded for 1983. Continental Lime Inc., Holly Sugar Corp., and The Great Western Sugar Co. produced lime in Broadwater, Richland, and Yellowstone Counties, respectively.

**Phosphate Rock.**—Phosphate rock production in the State increased 11% in quantity and 17% in value over that of 1983, owing to a continued partial recovery in the agricultural fertilizer market. Montana's only producer, Cominco, continued to mine phosphate at its underground Warm Springs Mine near Garrison in Powell County. Cominco can now ship phosphate on a year-round basis to its fertilizer plant at Kimberley, British Columbia, Canada, as a result of construction of a thawing facility for railroad hopper cars at that plant.

Stauffer Chemical Co. cited higher sales, reduced plant inventory, and generally improved economic conditions as reasons for restarting the second furnace at its Silver Bow elemental phosphorus plant near Butte. The plant processes phosphate ore from the company's Wooley Valley Mine in Idaho.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

The 1984 output of construction sand and gravel in Montana increased nearly 46% in quantity and 66% in value, and the unit value was up 14% from that reported for 1982, when the last complete canvass was taken. The largest increases were in the asphaltic concrete and other uses categories.

In 1984, five counties—Flathead, Gallatin, Missoula, Silver Bow, and Yellowstone—accounted for 57% of the State's total construction sand and gravel production tonnage. Major uses were for road base and coverings (25%), asphaltic concrete (25%), concrete aggregate (7%), and other uses (36%); the bulk of Montana's construction sand and gravel (98%) was transported by truck.

Table 6.—Montana: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 571 | $2,183 | $3.82 |
| Plaster and gunite sands | W | W | 2.30 |
| Concrete products | W | W | 4.44 |
| Asphaltic concrete | 1,936 | 6,517 | 3.37 |
| Road base and coverings[1] | 1,939 | 4,940 | 2.55 |
| Fill | 452 | 803 | 1.77 |
| Snow and ice control | 65 | 99 | 1.51 |
| Railroad ballast | 43 | 131 | 3.01 |
| Other[2] | 2,770 | 6,597 | 2.38 |
| Total or average | 7,776 | [3]21,269 | 2.74 |

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1] Includes road and other stabilization (cement and lime).
[2] Includes other unspecified uses and uses indicated by symbol W.
[3] Data do not add to total shown because of independent rounding.

*Industrial.*—Industrial sand and gravel was produced only in Park County.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Travertine building stone was produced by Livingston Marble & Granite Works from quarries near Gardiner in Park County and marketed from its plant at Livingston.

**Sulfur (Recovered).**—Montana Sulphur & Chemical Co. and Farmers Union Central Exchange recovered sulfur as a byproduct from petroleum refining in Yellowstone County. The amount of sulfur produced declined 15% and the value was down 12% from that reported in 1983.

**Talc.**—Montana ranked second in the Nation in 1984 for the quantity, and gained first ranking in the value of talc production for the year. The 1984 production increased 32% in quantity and 28% in value over that of 1983. All of the State's talc was open pit mined from deposits in the Ruby and Gravelly Ranges in Madison County. Cyprus Industrial Minerals Co. reactivated and expanded production at its Beaverhead Mine and stepped up production at its Yellowstone Mine; the ore was processed at its Three Forks mill. Pfizer Inc. operated its Treasure Chest Mine and Barretts mill south of Dillon. Uses for talc produced in Montana were in paint (29%), paper (18%), ceramics (10%), plastics (5%), cosmetics (4%), and other uses including rubber, roofing, refractories, and miscellaneous.

NICOR Mineral Ventures completed a final feasibility study on its Montana Talc project. The company plans to invest $10 million in a new open pit talc mine near Ennis and a mill on rail at Sappington. The mine, adjacent to Cyprus' Yellowstone Mine, has an identified 1-million-short-ton reserve; estimated mine life is 13 years. Exploration activity for talc increased in the Precambrian areas of southwestern Montana in 1984.

**Vermiculite.**—Montana again led the Nation in the production of vermiculite. Production in 1984 was about 92% of the yearly average for the 5-year period (1980-84); the value of production was 8% more than the yearly average for the 5-year period. W. R. Grace & Co. continued to mine and mill vermiculite at its Rainy Creek operation north of Libby in Lincoln County. Robinson Insulation Co. at Great Falls, Cascade County, produced exfoliated vermiculite, which was sold for building aggregates, insulation, and agricultural applications.

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[1] State Mineral Officer, Bureau of Mines, Spokane, WA.
[2] Acting director, Montana Bureau of Mines and Geology, Butte, MT.
[3] Staff field agent, Montana Bureau of Mines and Geology, Butte, MT.

## Table 7.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum: | | | |
| ARCO Aluminum Co., a division of Atlantic Richfield Co. | Columbia Falls, MT 59912 | Reduction plant | Flathead. |
| Barite: | | | |
| Montana Barite Co. Inc., a subsidiary of NICOR Mineral Ventures. | 6700 Desmet Rd.<br>Box 3296<br>Missoula, MT 59806 | Mine and plant | Lincoln and Missoula. |
| Cement: | | | |
| Ideal Basic Industries Inc., Cement Div.[1] | Box 8789<br>Denver, CO 80201 | Plant | Gallatin. |
| Kaiser Cement Corp.[1] | 300 Lakeside Dr.<br>Oakland, CA 94612 | do | Jefferson. |
| Clays: | | | |
| American Colloid Co | 5100 Suffield Ct.<br>Skokie, IL 60078 | Pits and plant | Carbon and Phillips. |
| Federal Bentonite Div., Aurora Industries Inc. | 609 Fifth Ave.<br>Belle Fourche, SD 57717 | Pit and plant | Valley. |
| International Minerals & Chemical Corp., Industrial Minerals Div. | Box 460<br>Belle Fourche, SD 57717 | Pits | Carter. |
| NL Industries Inc., Baroid Div | Box 1675<br>Houston, TX 77251 | Pit and plant | Do. |
| Copper: | | | |
| ASARCO Incorporated | Box 868<br>Troy, MT 59935 | Underground mine and plant. | Lincoln. |
| Gold: | | | |
| Golden Sunlight Mines Inc., a subsidiary of Placer U.S. Inc.[2] | Box 678<br>Whitehall, MT 59759 | Open pit mine and plant | Jefferson. |
| Pegasus Gold Inc.[2] | Zortman, MT 59546 | do | Phillips. |
| Gypsum: | | | |
| Maronick Construction Co. Inc.[3] | East Helena, MT 59635 | Open pit mine | Judith Basin. |
| United States Gypsum Co | Heath, MT 59457 | Underground mine and plant. | Fergus. |
| Lime: | | | |
| Continental Lime Inc | 268 West 400 South<br>Suite 201<br>Salt Lake City, UT 84101 | Open pit mine | Broadwater. |
| The Great Western Sugar Co | 1530 16th St.<br>Denver, CO 80217 | Surface mine and plant | Yellowstone. |
| Holly Sugar Corp | Box 1052<br>Colorado Springs, CO 80901 | do | Richland. |
| Phosphate rock: | | | |
| Cominco American Incorporated | Box 638<br>Garrison, MT 59731 | Underground mine | Powell. |
| Sand and gravel: | | | |
| Jim Gilman Excavating Inc | 3105 Kossuth<br>Butte, MT 59701 | Pits | Silver Bow. |
| Konitz Contracting Inc | Box 595<br>Lewistown, MT 59547 | Pit | Fergus. |
| Barry O'Leary Inc | 1041 North Fourth Ave.<br>Billings, MT 59103 | Pit | Yellowstone. |
| Shellenger Construction Co | Box 517<br>Columbia Falls, MT 59912 | Pits | Flathead. |
| United Industries, Midland Materials Co. | Box 30238<br>Billings, MT 59107 | do | Cascade and Yellowstone. |
| Washington Construction Co | Box 8989<br>Missoula, MT 59807 | Pit | Missoula. |
| Yellowstone County Highway Department. | Box 35023<br>Billings, MT 59107 | Pits | Yellowstone. |
| Silver: | | | |
| ASARCO Incorporated[4] | Box 868<br>Troy, MT 59935 | Underground mine and plant. | Lincoln. |
| Black Pine Mining Co.[4] | Box 610<br>Philipsburg, MT 59858 | Underground mine | Granite. |
| Stone (dimension): | | | |
| Livingston Marble & Granite Works | Box 851<br>Livingston, MT 59047 | Quarries and plant | Park. |
| Sulfur (recovered): | | | |
| Montana Sulphur & Chemical Co | Box 31118<br>Billings, MT 59107 | Plant | Yellowstone. |
| Talc: | | | |
| Cyprus Industrial Minerals Co., a subsidiary of Amoco Minerals Co. | Box 3299<br>7000 South Yosemite<br>Englewood, CO 80155 | Plant and open pit mines | Gallatin and Madison. |
| Pfizer Inc | Box 1147<br>Dillon, MT 59725 | Plant and open pit mine | Beaverhead and Madison. |
| Vermiculite: | | | |
| W. R. Grace & Co., Zonolite Div | 1114 Avenue of the Americas<br>New York, NY 10036 | do | Lincoln. |

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[1] Also clays and stone.
[2] Also silver.
[3] Also stone.
[4] Also copper, gold, and lead.

# The Mineral Industry of Nebraska

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Conservation and Survey Division of the University of Nebraska (Nebraska Geological Survey) for collecting information on all nonfuel minerals.**

## By Karl E. Starch[1] and Raymond R. Burchett[2]

The value of nonfuel minerals produced in Nebraska in 1984 was $100.4 million, a 15% increase over that of 1983. This was the second year of increased output, following a 3-year decline, and the highest value ever recorded for nonfuel mineral output in the State. Six nonfuel minerals were reported produced in the State: cement, clays, gem stones, lime, sand and gravel, and stone. All of these industrial minerals recorded increases in production and value during 1984. In most cases, value rose more than output.

Cement was the most important commodity produced and was responsible for most of the increase in value. Construction sand and gravel and crushed stone were the other leading commodities.

**Table 1.—Nonfuel mineral production in Nebraska[1]**

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Clays thousand short tons | 164 | $501 | 180 | $556 |
| Sand and gravel: | | | | |
| Construction do | $^{e}$10,100 | $^{e}$25,000 | 11,839 | 27,791 |
| Industrial do | 4 | W | W | W |
| Stone (crushed) do | 4,442 | 22,612 | $^{e}$4,500 | $^{e}$23,400 |
| Combined value of cement, gem stones, lime, and values indicated by symbol W | XX | 39,296 | XX | 48,621 |
| Total | XX | 87,409 | XX | 100,368 |

$^{e}$Estimated. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Nebraska, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Antelope | W | (2) | |
| Box Butte | (3) | -- | |
| Brown | $1 | (2) | |
| Buffalo | 711 | (2) | |
| Burt | 6 | (2) | |
| Butler | 267 | (2) | |
| Cass | 26,525 | $41,219 | Cement, stone (crushed), clays. |
| Cedar | 721 | (2) | |
| Chase | 122 | (2) | |
| Cheyenne | 66 | (2) | |
| Clay | W | (2) | |
| Colfax | 288 | (2) | |
| Cuming | W | (2) | |
| Custer | 158 | (2) | |
| Dawson | 959 | (2) | |
| Deuel | 136 | (2) | |
| Dixon | W | (2) | |
| Dodge | 541 | (2) | |
| Douglas | W | 10 | Clays. |
| Fillmore | W | (2) | |
| Franklin | 236 | (2) | |
| Frontier | 7 | (2) | |
| Furnas | 46 | (2) | |
| Gage | W | W | Stone (crushed). |
| Garden | 30 | (2) | |
| Hall | 670 | (2) | |
| Hamilton | W | (2) | |
| Hayes | W | (2) | |
| Hitchcock | W | (2) | |
| Holt | 760 | (2) | |
| Howard | 45 | (2) | |
| Jefferson | W | 247 | Clays. |
| Kearney | 58 | (2) | |
| Keith | 246 | (2) | |
| Knox | 313 | (2) | |
| Lancaster | 81 | W | Stone (crushed), clays. |
| Lincoln | 72 | (2) | |
| Loup | W | (2) | |
| Madison | 413 | (2) | |
| Merrick | 550 | (2) | |
| Morrill | W | W | Lime. |
| Nance | 189 | (2) | |
| Nemaha | W | W | Stone (crushed). |
| Nuckolls | W | W | Cement, stone (crushed). |
| Pawnee | (3) | W | Stone (crushed). |
| Perkins | 22 | (2) | |
| Phelps | 28 | (2) | |
| Pierce | W | (2) | |
| Platte | 1,164 | (2) | |
| Polk | W | (2) | |
| Red Willow | 758 | (2) | |
| Saline | 41 | (2) | |
| Sarpy | W | W | Stone (crushed), clays. |
| Saunders | 2,699 | W | Stone (crushed), sand (industrial). |
| Scotts Bluff | W | W | Lime. |
| Seward | (3) | 51 | Stone (crushed). |
| Sheridan | 68 | (2) | |
| Stanton | W | (2) | |
| Thayer | 1,166 | (2) | |
| Thomas | W | (2) | |
| Washington | (3) | W | Stone (crushed). |
| Webster | W | (2) | |
| York | W | (2) | |
| Undistributed[4] | 20,815 | 20,882 | |
| Sand and gravel (construction) | XX | [e]25,000 | |
| Stone (crushed) | [e]14,300 | XX | |
| Total | [5]75,280 | 87,409 | |

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[e] Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Crushed stone was produced; data not available by county. Total State value is shown separately under "Stone (crushed)."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Nebraska business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 1,589 | 1,596 | 1,606 |
| Total civilian labor force | do | 789 | 792 | 798 |
| Unemployment | do | 48 | 45 | 35 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 1.9 | 1.9 | 1.7 |
| Nonmetallic minerals except fuels[2] | do | .9 | .9 | NA |
| Oil and gas extraction[2] | do | 1.0 | .9 | NA |
| Manufacturing total | do | 87.9 | 84.7 | 89.0 |
| Primary metal industries[2] | do | 1.5 | 1.3 | NA |
| Stone, clay, and glass products[2] | do | 2.5 | 2.5 | NA |
| Chemicals and allied products | do | 2.6 | 2.5 | 2.6 |
| Petroleum and coal products | do | .2 | .2 | NA |
| Construction | do | 23.5 | 23.5 | 24.0 |
| Transportation and public utilities | do | 44.6 | 43.1 | 42.8 |
| Wholesale and retail trade | do | 158.5 | 157.8 | 160.8 |
| Finance, insurance, real estate | do | 41.4 | 41.9 | 43.2 |
| Services | do | 122.7 | 127.5 | 135.4 |
| Government and government enterprises | do | 129.3 | 130.2 | 131.7 |
| Total[3] | do | 609.8 | 610.8 | 628.5 |
| Personal income: | | | | |
| Total | millions | $17,261 | $17,661 | $19,962 |
| Per capita | | $10,861 | $11,068 | $12,430 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.9 | 40.3 | 40.5 |
| Total average hourly earnings, production workers | | $8.47 | $8.76 | $8.93 |
| Earnings by industry: | | | | |
| Farm income | millions | $930 | $642 | $1,374 |
| Nonfarm | do | $11,001 | $11,591 | $12,636 |
| Mining total | do | $60 | $45 | $55 |
| Nonmetallic minerals except fuels | do | $14 | $16 | $20 |
| Oil and gas extraction | do | $46 | $30 | $35 |
| Manufacturing total | do | $1,827 | $1,870 | $2,100 |
| Primary metal industries | do | $40 | $40 | $51 |
| Stone, clay, and glass products | do | $51 | $54 | $57 |
| Chemicals and allied products | do | $65 | $69 | $74 |
| Petroleum and coal products | do | $6 | $6 | $8 |
| Construction | do | $569 | $603 | $696 |
| Transportation and public utilities | do | $1,297 | $1,358 | $1,434 |
| Wholesale and retail trade | do | $2,174 | $2,218 | $2,372 |
| Finance, insurance, real estate | do | $797 | $880 | $959 |
| Services | do | $2,011 | $1,214 | $2,452 |
| Government and government enterprises | do | $2,214 | $2,348 | $2,509 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 3,851 | 5,526 | 6,053 |
| Value of nonresidential construction | millions | $200.6 | $192.5 | $289.8 |
| Value of State road contract awards | do | $110.1 | $191.1 | $154.3 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 687 | 726 | 835 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $75.3 | $87.4 | $100.4 |
| Value per capita | | $47 | $55 | $62 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

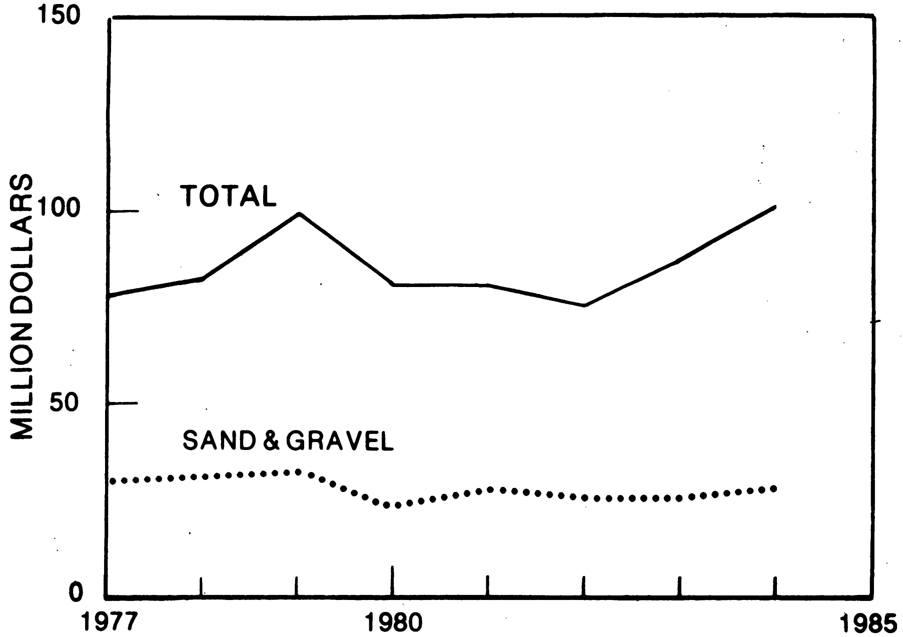

**Figure 1.**—Value of sand and gravel and total value of nonfuel mineral production in Nebraska.

A continuing, though modest, economic recovery in the State was responsible for the rise in demand for the industrial minerals produced by the State's nonfuel mineral industry. The Plains region did not keep pace with national gains in the 1982-84 period; for example, employment growth was 2.4%, compared with the national rate of 4.2%. Nebraska, however, did a little better than most other Plains States, with an increase in employment of 3.1%.

Only 62 of Nebraska's 93 counties reported nonfuel mineral production in 1983, the most recent year for which county data are available. Of these, 48 produced only sand and gravel, 10 produced crushed stone, and 2 produced cement.

"The Nebraska Mineral Operations Review, 1984," published by the Nebraska Geological Survey, reported 689 active mining operations in Nebraska in 1984, including 636 sand, gravel, and silt or siltstone pits; 29 limestone quarries; 18 sandstone pits; and 6 clay or shale pits. These operations disturbed 433 acres of land, and operators restored 574 acres during the year. A total of 3,349 quarries, pits, and mines, including 14 coal mines, were estimated to have operated in Nebraska at various times over the past 85 years.

About 1,700 people were employed in the mining industry in Nebraska in 1984, including oil and gas workers, about 300 more than in 1983. These 1,700 represented about three-tenths of 1% of the total work force of 628,500 people.

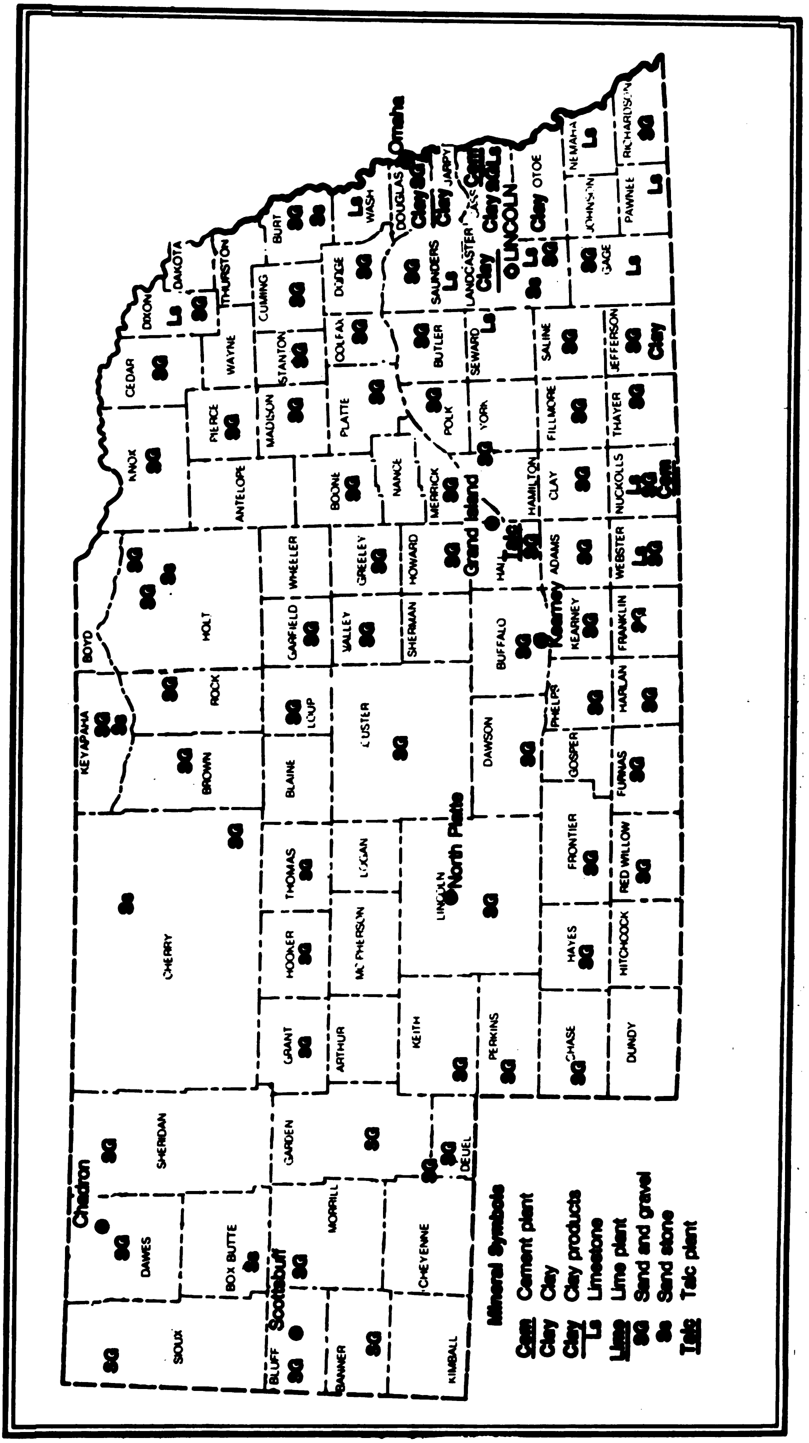

Figure 2.—Principal mineral producing localities in Nebraska.

**Exploration Activities.**—Wyoming Fuels Co., a subsidiary of KN Energy Inc. (formerly Kansas-Nebraska Gas Co.), received a source materials license from the Nuclear Regulatory Commission for a pilot solution-mining operation at its large uranium prospect in northwestern Nebraska. Approvals from the U.S. Environmental Protection Agency and the Nebraska Department of Environmental Control were still required. Wyoming Fuels estimated reserves of more than 30 million pounds of $U_3O_8$ in ore grading an average 0.25% or more in its Crow Butte property, a mineralized trend about 6 miles long and 1/2 mile wide, 22 miles south of Chadron. A pilot operation of about 100 gallons per minute was planned to test commercial feasibility.

Molycorp Inc. continued its evaluation of the Elk Creek carbonatite of southeastern Nebraska, thought to have a potential for rare-earth production. Also in southeastern Nebraska, Texaco Petroleum Products Inc., KEWA Exploration Inc. of Denver, CO, and Leasehold Ltd. of Englewood, CO, were exploring a geologic structure known as the Midcontinent (or Keweenawan) Rift for oil and gas.

**Legislation and Government Programs.**—No legislation pertaining specifically to the nonfuel mineral industry was passed or considered by the Nebraska legislature in 1984.

Among maps produced during 1984 by the Nebraska Geological Survey to aid mineral development were Depth to Precambrian Rocks in Nebraska and Configuration Map on Top of the Devonian (Hunton) Carbonate in Nemaha and Richardson Counties. Projects in progress during the year included (1) a summary of the Niobrara Formation stratigraphy and geologic history in northwestern Nebraska, (2) geologic mapping in western Nebraska, (3) sedimentology and chronology of the Nebraska Sandhills, (4) a study of the Cherokee Formation (Pennsylvanian) in Nebraska, and (5) stratigraphic test drilling in the eastern Nebraska Sandhills.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Ammonium Nitrate.**—The Homestead ammonium nitrate plant of Cominco American Incorporated at Beatrice sold 9% more fertilizer than in 1983, according to the company's 1984 annual report. Several small energy saving projects had the cumulative effect of reducing by 15% the consumption of natural gas, the most expensive component in the production of ammonium nitrate. The plant had 61 employees at yearend 1984, and production was 140,400 metric tons, up 25.2% from that of 1983. A new $1 million urea-ammonium nitrate solution facility was scheduled for completion in 1985 to meet increased demand for liquid fertilizer in the Midwest market area.

**Cement.**—Cement led in value among Nebraska's nonfuel minerals in 1984. Both volume and value of output increased 21% over the 1983 level. Two companies produced cement in Nebraska in 1984, Ash Grove Cement Co. at Louisville, Cass County, and Ideal Basic Industries Inc. at Superior, Nuckolls County, both in southeastern Nebraska. Ash Grove's plant was considerably the larger of the two. Output at both plants was primarily Types I and II, general use and moderate heat portland cement. A small amount of masonry cement also was produced at the Ash Grove plant.

Nearly two-thirds of the cement produced was sold to ready-mixed concrete companies, nearly one-quarter to highway contractors, and the balance to concrete product manufacturers, other contractors, and building material dealers. Most cement was shipped in bulk by truck directly to the consumer. Shipments in 1984 were partially from existing stocks.

The Ash Grove plant used a dry manufacturing process, and the Ideal Basic plant used a wet process. Both plants were equipped with electrostatic precipitators. Clays, gypsum, iron ore, limestone, and sandstone were the raw materials used in cement manufacture. The average value of finished portland cement sold was $56.26 per short ton.

**Clays.**—Output of clay in Nebraska increased about 10% in 1984 over that of 1983. Only common clay was produced, and output was by four companies in five counties. Endicott Clay Products Co., with an operation in Jefferson County, was the largest clay producer. Ash Grove, with an operation in Cass County, was second largest; Yankee Hill Brick Manufacturing Co., with one operation in Lancaster County, was third; and Omaha Brick Works, with two smaller operations in Douglas and Sarpy Counties, was fourth. All four operated in Nebraska's more populated southeastern corner, near metropolitan Omaha and Lincoln. Three companies, Endicott Clay Products, Yankee Hill Brick, and Omaha Brick, produced mostly face brick for the construction industry. A very small amount of common brick was produced. Ash Grove's clay output went into the manufacture of cement. Value of clay produced averaged $3.09 per short ton, but ranged from $3.00 to $8.00 per ton.

**Gem Stones.**—Numerous small firms around the State cut and polished gems and ornamental stones such as agate, chalcedony, chert, jasper, petrified wood, and quartz.

**Lime.**—The Great Western Sugar Co. reported producing quicklime from limestone quarried in Wyoming at Bayard in Morrill County and at Scottsbluff, Gering, and Mitchell in Scottsbluff County. The amount reported was 40% greater than in 1983, and the value was nearly double. The lime was used at Great Western's sugar beet plants in processing sugar beets into sugar. Great Western announced at yearend that its sugar refining facilities were for sale.

**Perlite (Expanded).**—The Zonolite Division of W. R. Grace & Co. expanded perlite brought in from other States at its plant near Omaha and sold it as filler material, an aggregate for plaster and concrete, and as a horticultural product.

**Sand and Gravel.**—Sand and gravel was the most widely produced mineral in Nebraska; output came from 48 of 93 counties, and sand and gravel was second only to cement in total value.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of construction sand and gravel increased 17% in 1984 over the 1983 level. Douglas was the largest producing county, followed by Buffalo, Saunders, Hall, and Cass. These five counties together accounted for 39% of total State output. Three of the leading counties were part of metropolitan Omaha; the others were in or near major towns.

Construction sand and gravel was produced by 122 companies and government agencies from 205 pits. Most operations were small. The five leading companies produced about 40% of the total from 22 pits. In contrast, the smallest 62 companies produced 10% of the total from 84 pits. The largest single producer was Lyman-Richey Sand & Gravel Corp. in the Omaha area, followed in size by Western Sand & Gravel Co. and Hartford Sand & Gravel Co., both of which also operated in the Omaha area, and by Central Paving Sand & Gravel Co. Inc. and Stalph Gravel Co. in the eastern Nebraska area.

The major uses of construction sand and gravel in Nebraska included road base and coverings, 21%; concrete aggregate, 9%; asphaltic concrete, 3%; and fill, 2%. Lesser uses included concrete products, plaster and gunite sands, roofing granules, and snow and ice control. Value averaged $2.35 per short ton and ranged from $1.44 to $3.76 per ton.

**Table 4.—Nebraska: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 1,115 | $2,935 | $2.63 |
| Plaster and gunite sands | 88 | 190 | 2.17 |
| Concrete products | 122 | 282 | 2.32 |
| Asphaltic concrete | 390 | 1,279 | 3.28 |
| Road base and coverings[1] | 2,454 | 6,277 | 2.56 |
| Fill | 259 | 454 | 1.75 |
| Snow and ice control | 22 | 64 | 2.85 |
| Other[2] | 7,388 | 16,311 | 2.21 |
| Total[3] or average | 11,839 | 27,791 | 2.35 |

[1] Includes road and other stabilization (cement and lime).

[2] Includes other unspecified uses.

[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—Industrial sand output increased about 25%, but was a miniscule portion of total sand and gravel production. One company, Western Sand & Gravel in Saunders County, produced industrial sand. Its output was used mostly for sandblasting but also for traction sand. Average value was about $7.60 per short ton.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Only crushed stone was produced in Nebraska in 1984. Stone was third in importance among Nebraska's nonfuel minerals. Output in 1984 was little different from output in 1983. There were approximately 17 limestone plants in the eastern third of Nebraska. Principal producers were Fort Calhoun Stone Co., Kerford Limestone Co., and Martin Marietta Aggregates. Cass and Washington Counties were leaders in production. Crushed limestone was used for concrete aggregate, cement manufacture, road base and coverings, riprap, agricultural limestone, and mineral fillers.

Three firms produced agricultural limestone exclusively. They were situated near Garland in Steward County, near Nelson in Nuckolls County, and near Ponca in Dixon County. Most pulverized limestone plants in southeastern Nebraska produced some agricultural limestone.

Stone brought in from other States was cut by Nebraska firms, seven of which were in the Omaha area. Texasgulf Inc. and American Cyanamid Co. produced dicalcium phosphate and/or monocalcium phosphate from limestone at facilities in Weeping Water for use in livestock and poultry feed.

**Talc.**—Cyprus Industrial Minerals Co.'s United Sierra Div. plant near Grand Island in Hall County was the only processor of ground talc in Nebraska. The unground talc was obtained from outside the State. The ground product was used in paper, ceramics, rubber, paint, insecticides, textiles, and toilet articles.

**Vermiculite (Exfoliated).**—W. R. Grace exfoliated crude vermiculite brought in from Montana at its Construction Products Div. plant near Omaha. The expanded product was used for insulation, concrete aggregate, and fireproofing.

## METALS

Lead bullion from smelters outside the State was processed at the Omaha refinery of ASARCO Incorporated to produce refined and antimonial lead and refined bismuth. The refinery also recovered antimony, antimony oxide, copper, zinc, and doré containing silver and gold. Total rated annual capacity of the refinery was 180,000 tons of metal.

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[1] State Mineral Officer, Bureau of Mines, Denver, CO.

[2] Research geologist, Conservation and Survey Division, University of Nebraska (Nebraska Geological Survey), Lincoln, NE.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Ash Grove Cement Co.[1] | 920 Main St.<br>Suite 1000<br>Kansas City, MO 64105 | Plant | Cass. |
| Ideal Basic Industries Inc., Ideal Cement Co. | Box 8789<br>Denver, CO 80201 | do | Nuckolls. |
| Clays: | | | |
| Endicott Clay Products Co | Box 17<br>Fairbury, NE 68352 | Open pit and plant | Jefferson. |
| Yankee Hill Brick Manufacturing Co. | Route 1<br>Lincoln, NE 68502 | do | Lancaster. |
| Sand and gravel (construction): | | | |
| Central Paving Sand & Gravel Co. Inc | Box 626<br>Columbus, NE 68601 | Pits and plants | Butler, Platte, York. |
| Hartford Sand & Gravel Co. | Box Z<br>Valley, NE 68064 | Dredges and pits | Dodge, Douglas, Hall. |
| Lyman-Richey Sand & Gravel Corp | 4315 Cuming St.<br>Omaha, NE 68131 | Pits and plants | Cass, Douglas, Morrill, Platte, Saunders. |
| Stalph Gravel Co | Box 6<br>West Point, NE 68788 | Pit and plant | Cuming. |
| Western Sand & Gravel Co.[2] | Box 28<br>Ashland, NE 68003 | do | Cass, Dodge, Saunders. |
| Stone: | | | |
| Fort Calhoun Stone Co | 1255 South St.<br>Blair, NE 68008 | Quarries and plants. | Washington. |
| Kerford Limestone Co | Box 449<br>Weeping Water, NE 68463 | Quarry and plant | Cass. |
| Martin Marietta Aggregates, Central Div. | Box 30013<br>Raleigh, NC 27622 | Quarries and plants. | Cass, Nemaha, Nuckolls, Pawnee, Saunders. |

[1] Also clays and limestone in Cass County.
[2] Also industrial sand in Saunders County.

# The Mineral Industry of Nevada

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Nevada Bureau of Mines and Geology for collecting information on all nonfuel minerals.**

### By Fred V. Carrillo[1] and John H. Schilling[2]

The value of Nevada's nonfuel mineral production in 1984 was $616 million, a slight increase from that recorded in 1983. Nevada ranked 11th nationally in the value of nonfuel mineral production. Gold continued to be the leading commodity produced in terms of value, accounting for $360 million or 58% of the total nonfuel mineral value produced in the State. The 7% decline in value of gold production was the result of lower gold prices in 1984. Total production of 997,508 troy ounces was a 9% increase over that in 1983.

The State continued to lead the Nation in the production of barite and gold and was the sole producer of mined magnesite and mercury.

**Table 1.—Nonfuel mineral production in Nevada[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Barite thousand short tons | 663 | $21,736 | 615 | $14,924 |
| Clays do. | 58 | 2,348 | [2]20 | [2]1,191 |
| Gem stones | NA | 1,200 | NA | 1,300 |
| Gold (recoverable content of ores, etc.) troy ounces | [r]914,531 | [r]387,761 | 997,508 | 359,759 |
| Gypsum thousand short tons | 998 | 7,896 | 1,192 | 8,860 |
| Lead (recoverable content of ores, etc.) metric tons | 14 | 7 | W | W |
| Mercury 76-pound flasks | 25,070 | W | 19,048 | W |
| Sand and gravel: | | | | |
| Construction thousand short tons | [e]7,500 | [e]16,200 | 8,202 | 20,505 |
| Industrial do. | W | W | 489 | W |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 5,164 | 59,073 | 6,477 | 52,727 |
| Stone (crushed) thousand short tons | 1,269 | 5,358 | [e]1,100 | [e]4,700 |
| Combined value of cement (portland), clays (fuller's earth and kaolin, 1984), copper, diatomite, fluorspar, iron ore, lime, lithium, magnesite, molybdenum, perlite, salt, tungsten ore and concentrate (1984), and values indicated by symbol W | XX | [r]111,178 | XX | 151,787 |
| Total | XX | [r]612,757 | XX | 615,753 |

[e] Estimated. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth and kaolin; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Nevada, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Carson City | $26 | (2) | |
| Churchill | 1,080 | W | Diatomite, salt, iron ore, silver, gold, lead. |
| Clark | 27,855 | $23,883 | Lime, sand and gravel (industrial), gypsum, stone (crushed). |
| Douglas | 669 | (2) | |
| Elko | 97,748 | W | Gold, barite, silver, lead, copper. |
| Esmeralda | 27,478 | 43,405 | Lithium, silver, gold, diatomite, clays. |
| Eureka | 59,254 | W | Gold, barite, iron ore, stone (crushed), mercury, silver. |
| Humboldt | 33,899 | W | Gold, mercury, stone (crushed), clays. |
| Lander | 71,141 | 77,937 | Gold, barite, copper, silver, lead. |
| Lincoln | 8,230 | W | Gold, silver, perlite. |
| Lyon | 20,220 | W | Cement, stone (crushed), gypsum, diatomite, gold, silver. |
| Mineral | 26,871 | 47,909 | Gold, silver, lead, copper. |
| Nye | 91,692 | 61,083 | Gold, clays, molybdenum, barite, magnesite, silver, copper, stone (crushed), fluorspar. |
| Pershing | 23,096 | W | Diatomite, gypsum, silver, gold, perlite, iron ore, copper, lead. |
| Storey | 5,870 | 16,068 | Diatomite, silver, gold, stone (crushed). |
| Washoe | W | W | Clays, gold, silver. |
| White Pine | W | W | Gold, silver. |
| Undistributed[3] | 32,833 | 326,270 | |
| Sand and gravel (construction) | XX | 16,200 | |
| Stone (crushed) | [e]4,500 | XX | |
| Total[4] | 532,463 | 612,757 | |

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] County distribution for construction sand and gravel (1983) and crushed stone (1982) was not available; total State values are shown separately under "Sand and gravel (construction)" or "Stone (crushed)."

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Includes some gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Nevada business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 876 | 897 | 911 |
| Total civilian labor force | do | 482 | 486 | 496 |
| Unemployment | do | 49 | 48 | 39 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 6.6 | 5.8 | 6.6 |
| Metal mining | do | 4.2 | 4.1 | 4.8 |
| Manufacturing total | do | 18.8 | 19.1 | 21.0 |
| Primary metal industries | do | 1.4 | 1.1 | 1.1 |
| Stone, clay, and glass products | do | 1.3 | 1.2 | 1.4 |
| Chemicals and allied products | do | .8 | .7 | .7 |
| Construction | do | 20.0 | 19.4 | 22.3 |
| Transportation and public utilities | do | 24.9 | 24.5 | 24.8 |
| Wholesale and retail trade | do | 79.9 | 80.3 | 86.0 |
| Finance, insurance, real estate | do | 17.9 | 18.5 | 20.1 |
| Services | do | 174.8 | 177.2 | 187.3 |
| Government and government enterprises | do | 58.2 | 58.0 | 59.0 |
| Total | do | 401.1 | 402.8 | 427.1 |
| Personal income: | | | | |
| Total | millions | $10,474 | $11,074 | $12,132 |
| Per capita | | $11,742 | $12,351 | $13,320 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 37.3 | 38.8 | 39.8 |
| Mining | | 41.2 | 43.0 | 42.8 |
| Total average hourly earnings, production workers | | $8.80 | $9.02 | $9.12 |
| Mining | | $11.53 | $12.27 | $12.87 |
| Earnings by industry: | | | | |
| Farm income | millions | $49 | $50 | $54 |
| Nonfarm | do | $7,754 | $8,203 | $8,963 |
| Mining total | do | $135 | $149 | $176 |
| Metal mining | do | W | $101 | $124 |
| Nonmetallic minerals except fuels | do | W | $38 | $39 |
| Oil and gas extraction | do | W | $10 | $13 |

See footnotes at end of table.

**Table 3.—Indicators of Nevada business activity —Continued**

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Earnings by industry—Continued | | | |
| Manufacturing total millions | $417 | $439 | $503 |
| Primary metal industries do. | $47 | $36 | $39 |
| Stone, clay, and glass products do. | $33 | $35 | $41 |
| Chemicals and allied products do. | $23 | $22 | $22 |
| Petroleum and coal products do. | W | $2 | $2 |
| Construction do. | $592 | $581 | $620 |
| Transportation and public utilities do. | $657 | $709 | $745 |
| Wholesale and retail trade do. | $1,139 | $1,172 | $1,301 |
| Finance, insurance, real estate do. | $300 | $339 | $387 |
| Services do. | $3,138 | $3,338 | $3,700 |
| Government and government enterprises do. | $1,352 | $1,448 | $1,502 |
| Construction activity: | | | |
| Number of private and public residential units authorized | 8,319 | 16,170 | 13,184 |
| Value of nonresidential construction millions | $257.9 | $456.9 | $430.3 |
| Value of State road contract awards do. | $77.0 | $64.0 | $168.0 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 405 | 459 | 503 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $532.5 | $612.8 | $615.8 |
| Value per capita | $608 | $683 | $676 |

[r] Revised. [p] Preliminary. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

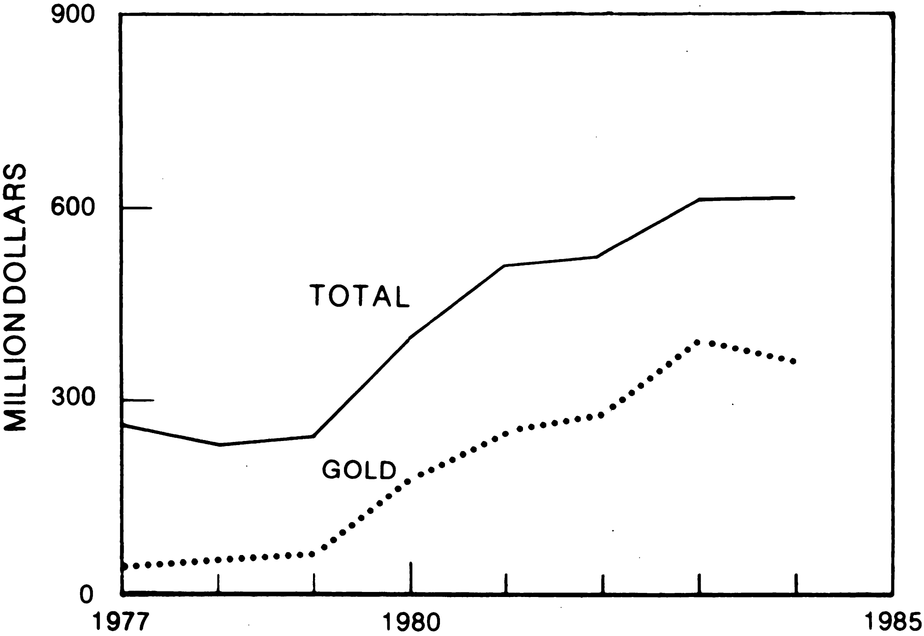

Figure 1.—Value of gold and total value of nonfuel mineral production in Nevada.

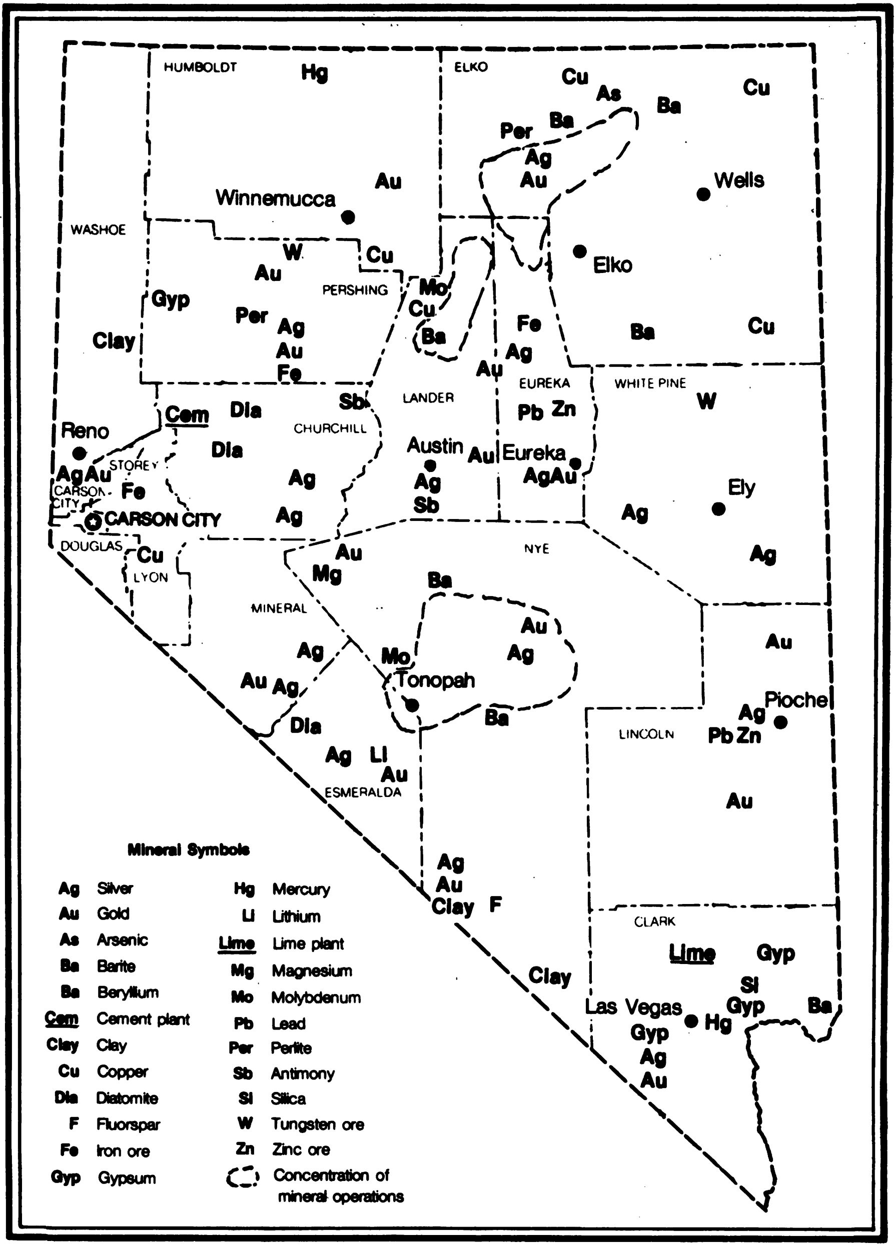

Figure 2.—Principal mineral producing localities in Nevada.

**Trends and Developments.**—Mineral prices were depressed, and several mines in Nevada suspended operations during the year. Barite mining remained at depressed levels throughout the year, owing to reduced demand for the commodity by the oil industry and to foreign competition. Lower prices and a lessening of demand also resulted in a nearly complete curtailment of copper and molybdenum mining in the State and the closure of several silver producers at yearend. Gold production continued to be the one bright spot in metal mining in the State. Despite lower prices than in 1983, heap leaching operations at open pit disseminated gold deposits nearly doubled.

Exploration for minerals declined in Nevada during 1984, with continuing layoffs and the closing of exploration offices. An intensive interest in gold deposits continued, however, and exploration for that commodity remained at a relatively high level (for details, see the "Gold" section), despite reductions in exploration efforts for barite, copper, molybdenum, and silver. The U.S. Bureau of Land Management (BLM) reported that more new claims (36,698) were recorded in Nevada in 1984 than in any other Western State.

With the exception of barite, exploration for most other industrial minerals increased as demand for these commodities continued to expand rapidly from the lows experienced in 1982. Industrial minerals that appeared to be most sought after were swelling clays, diatomite, gypsum, limestone, salt, and silica.

**Employment.**—According to the Nevada Employment Security Department, approximately 6,600 workers were employed in the Nevada mineral industry in 1984. The department reported an annual average of 4,800 employees in metal mining and 1,800 in other mining categories. The annual payroll for the State's mining industry was approximately $183 million.

Statistics collected by the Nevada Division of Mine Inspection showed that 6,218 workers were employed in 408 active operations during 1984. The largest number of employees were in the sand and gravel industry and in gold operations.

**Legislation and Government Programs.**—Two grants were made during 1984 to the Mackay School of Mines, University of Nevada—Reno, for research in the treatment of mineral industry waste for the recovery of critical minerals and metals. The U.S. Bureau of Mines allotted $150,000 to the Mineral Research Institute and $773,000 to the Waste Treatment and Recovery Generic Center at the Institute.

The Nevada Economic Development Commission funded a study entitled "A Custom Mill Feasibility Study" to be conducted in Mineral County.

The Nevada Bureau of Mines and Geology published 12 reports and maps on mineral resources during the year and reprinted 4 others. Thirty-one projects were under way at yearend, including geochemical, gravity, and geologic maps; statewide studies of barite, gold, manganese, mercury, and tungsten; and an inventory of mineral occurrences and deposits in several large areas of the State.

Total payments made by the BLM to the State of Nevada as its share of Federal mineral leasing receipts in 1984 amounted to $8,862,000.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

**Copper.**—Nevada dropped to seventh place in the ranking of copper producing States for 1984. Production was principally byproduct copper from a Pennzoil Co. subsidiary, Duval Corp.'s Battle Mountain Mine in Lander County, and an Atlantic Richfield Co. subsidiary, The Anaconda Minerals Co.'s Nevada Moly operation in Nye County. Kennecott's copper smelter in White Pine County remained closed during the year owing to a shortage of concentrates for custom smelting.

**Gold.**—Nevada was the leading gold producing State in the Nation in 1984, with 11 mines among the top 25 producing gold mines in the Nation. Exploration activity was brisk, and several new discoveries and mine openings were announced during the year.

Freeport Gold Co.'s Enfield Bell (Jerritt Canyon) Mine continued to be the State's largest gold operation. Freeport Gold reported that production was down from the 262,000 troy ounces produced during 1983, but still well above the designed capacity of 200,000 troy ounces. Total ore mined during the year reached a record-high level, and mill throughput rose 11% over that of 1983.

Newmont Mining Corp. began development early in the year of the Gold Quarry gold deposit north of Carlin, in northern Eureka County. Reported reserves of more than 8 million ounces of gold make the deposit the second largest in the State.

AMAX Inc. announced the discovery of a gold-silver ore body at its Sleeper property in the Awakening (Slumbering Hills) mining district, Humboldt County. Initial planning was announced for a 500-ton-per-day open pit mine to be under way in 1985.

Atlas Corp. announced the discovery of a new gold deposit—the Gold Bar—on the southwest flank of the Roberts Mountains in Eureka County. More than 200 test holes have indicated at least 2.25 million tons of ore averaging 0.09 ounce of gold per ton. Production is planned before the end of 1985.

Lacana Gold Inc. of Reno, a 70% owned subsidiary of Lacana Mining Corp. of Toronto, Ontario, Canada, began operations at the Relief Canyon open pit gold mine 20 miles east of Lovelock, Pershing County. Construction of the gold recovery plant and leach facilities began in June. Leaching began in September, and the first bullion was poured in October. Annual recovery of approximately 24,500 troy ounces of gold was anticipated.

Lacana Gold, together with its joint venture partners including Rayrock Mines Inc., began production at the Dee gold mine, northwest of the Carlin gold mine, in Elko County. The mine is expected to produce about 38,000 troy ounces of gold per year plus an equal amount of silver.

Production also began at Pinson Mining Co.'s Preble deposit northeast of Winnemucca, with an expected annual yield of about 17,000 troy ounces of gold. Earlier in the year, Pinson began testing its new CX Zone, an ore body discovered immediately northeast of the Pinson pit.

Duval began production at its new Fortitude gold and silver mine adjacent to its Battle Mountain Mine in Lander County. When fully operational, the new mine is expected to yield 200,000 troy ounces of gold and more than 250,000 troy ounces of silver per year. Fortitude, discovered in 1981, is considered to be the fifth largest deposit in Nevada.

FMC Corp. announced early in the year the discovery of a major gold-silver deposit at Paradise Peak in northwestern Nye County. The deposit is estimated to contain 1.2 million troy ounces of gold and 43.2 million troy ounces of silver, according to FMC's 1984 annual report. Late in the year, FMC contracted with Davy McKee Corp. for engineering, procurement, and construction services.

The Standard Slag Co. began production in August at its new Lewis Mine, a 3,500-ton-per-day open pit heap leach gold and silver operation in Humboldt County. It was the first mining project to receive a State authorized loan ($2 million) to partially finance development—the first industrial development bond for a mining operation in Nevada.

Production was also reported from Tenneco Minerals Co.'s Manhattan Mine, 50 miles northeast of Tonopah; Sunshine Mining Co.'s 16-to-1 Mine near Silver Peak, which processed a record high of 20,840 tons of ore in October; Placer U.S. Inc.'s Bald Mountain Mine in northwestern White Pine County, which produced 3,500 troy ounces of gold from 66,000 tons of ore during 2 months of operation; and Minex Resources Inc.'s heap leach Fire Creek gold mine in Crescent Valley, northern Nye County.

Cominco American Inc.'s open pit Buckhorn Mine in Eureka County started up in June but was shut down in November for modification of the ore handling and crushing equipment. The small heap leach operation utilized a cement agglomeration step to enhance the effectiveness of the leaching process.

Exploration continued at high levels throughout the State. Aurun Mines Ltd. explored the Bluebird property in northwest Lander County. Black Hawk Mine Corp. drilled a property in Goldfield. Nevex Gold Co. conducted exploration at the Haywood-Santiago Mine near Virginia City and began mining operations in the fall. Pacific Silver Corp. explored the old Buckskin Mine in Douglas County. Placer Development Co. Ltd. completed drilling on the summit of Mount Tennabo near the Horse Canyon Mine in Eureka County and also drilled near the Bald Mountain Mine in White Pine County. United States Steel Corp. did exploratory drilling in the Ivanhoe mining district in southwestern Elko County. Westley Mines Ltd. drilled the Atchison gold property in the Santa Fe mining district of Mineral County in a joint venture with Lacana Gold. Coeur d'Alene Mines Corp. explored its Rochester claims east of Oreana in Pershing County. Freeport Minerals Co. explored its Mesona gold property in Elko County.

### Table 4.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

| County | Mines producing[1] |  | Material sold or treated[2] (metric tons) | Gold |  | Silver |  |
|---|---|---|---|---|---|---|---|
|  | Lode | Placer |  | Troy ounces | Value | Troy ounces | Value |
| 1982, total | 45 | 3 | 11,541,462 | 757,099 | $284,601,088 | 3,142,263 | $24,980,993 |
| 1983, total | 34 | 4 | [r]15,283,956 | [r]914,531 | [r]387,761,144 | 5,163,724 | 59,073,002 |
| 1984: |  |  |  |  |  |  |  |
| Churchill | 1 | -- | 200 | 13 | 4,689 | 1,656 | 13,481 |
| Clark | 1 | -- | W | W | W | W | W |
| Elko | 1 | -- | W | W | W | W | W |
| Esmeralda | 1 | -- | W | W | W | W | W |
| Eureka | 4 | -- | W | W | W | W | W |
| Humboldt | 1 | -- | W | W | W | -- | -- |
| Lander | 3 | 1 | W | W | W | W | W |
| Lincoln | 1 | -- | W | W | W | W | W |
| Mineral | 3 | -- | W | W | W | W | W |
| Nye | 4 | -- | 11,853,589 | 192,525 | 69,435,681 | 177,265 | 1,443,054 |
| Pershing | 1 | -- | W | W | W | W | W |
| Storey | 2 | -- | W | W | W | W | W |
| White Pine | 2 | -- | W | W | W | W | W |
| Total | 25 | 1 | [3]24,243,883 | [3]997,508 | [3]359,759,244 | [3]6,477,032 | [3]52,727,314 |

| County | Copper |  | Lead |  | Zinc |  | Total value |
|---|---|---|---|---|---|---|---|
|  | Metric tons | Value | Metric tons | Value | Metric tons | Value |  |
| 1982, total | W | W | W | W | -- | -- | $320,640,459 |
| 1983, total | W | W | 14 | $6,576 | -- | -- | W |
| 1984: |  |  |  |  |  |  |  |
| Churchill | (4) | $26 | (4) | 279 | -- | -- | 18,475 |
| Clark | -- | -- | -- | -- | -- | -- | W |
| Elko | -- | -- | -- | -- | -- | -- | W |
| Esmeralda | -- | -- | -- | -- | -- | -- | W |
| Eureka | -- | -- | -- | -- | -- | -- | W |
| Humboldt | -- | -- | -- | -- | -- | -- | W |
| Lander | W | W | -- | -- | -- | -- | W |
| Lincoln | -- | -- | -- | -- | -- | -- | W |
| Mineral | -- | -- | W | W | -- | -- | W |
| Nye | W | W | W | W | -- | -- | W |
| Pershing | -- | -- | -- | -- | -- | -- | W |
| Storey | -- | -- | -- | -- | -- | -- | W |
| White Pine | -- | -- | -- | -- | -- | -- | W |
| Total | W | W | W | W | -- | -- | [3]420,812,256 |

[r]Revised. W Withheld to avoid disclosing company proprietary data.

[1]Operations from which gold and silver are recovered as byproducts from sand and gravel operations and operations from which silver and copper are recovered as byproducts of tungsten ore are not counted as producing mines.

[2]Excludes gravel washed.

[3]Includes items indicated by symbol W.

[4]Less than 1/2 unit.

### Table 5.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by class of ore or other source material

| Source | Number of mines[1] | Material sold or treated[2] (metric tons) | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|---|---|
| Lode ore:[3] | | | | | | | |
| Dry gold | 16 | 14,350,889 | 948,505 | 592,854 | -- | -- | -- |
| Gold-silver | 3 | W | W | W | -- | -- | -- |
| Silver | 6 | 2,733,381 | 17,352 | 4,589,445 | W | W | -- |
| Total | 25 | W | W | W | W | W | -- |
| Copper | 1 | W | -- | -- | W | -- | -- |
| Other lode material: | | | | | | | |
| Gold cleanup | 1 | W | W | W | -- | -- | -- |
| Silver tailings | -- | W | W | W | -- | -- | -- |
| Copper precipitates | 1 | W | -- | -- | W | -- | -- |
| Molybdenum ore | -- | W | W | W | W | W | -- |
| Total | 2 | W | W | W | W | W | -- |
| Total lode | 25 | [4]24,243,883 | W | [4]6,477,032 | W | W | -- |
| Placer | 1 | -- | W | -- | -- | -- | -- |
| Grand total | 26 | [4]24,243,883 | [4]997,508 | [4]6,477,032 | W | W | -- |

W Withheld to avoid disclosing company proprietary data.

[1] Detail may not add to totals shown because some mines produce more than one class of material. Operations from which metals were recovered from tailings or as byproducts from molybdenum ore are not counted as producing mines.

[2] Excludes gravel washed.

[3] Includes material that was leached.

[4] Includes items indicated by symbol W.

### Table 6.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by type of material processed and method of recovery

| Type of material processed and method of recovery | Gold (troy ounces) | Silver (troy ounces) | Copper (metric tons) | Lead (metric tons) | Zinc (metric tons) |
|---|---|---|---|---|---|
| Lode: | | | | | |
| Cyanidation | 917,107 | 5,131,084 | -- | -- | -- |
| Acid leaching (vat, tank, heap) | 68,397 | 78,598 | -- | -- | -- |
| Smelting of concentrates | 1,356 | 1,263,334 | W | W | -- |
| Direct smelting of: | | | | | |
| Ore | W | W | -- | -- | -- |
| Precipitates | -- | -- | W | -- | -- |
| Cleanup | W | W | -- | -- | -- |
| Total lode material | W | [1]6,477,032 | W | W | -- |
| Placer | W | -- | -- | -- | -- |
| Grand total | [1]997,508 | [1]6,477,032 | W | W | -- |

W Withheld to avoid disclosing company proprietary data.

[1] Includes items indicated by symbol W.

**Iron Ore.**—Nevada ranked seventh in 1984 among the 10 States that reported shipments of usable iron ore. Quantity and value rose 43% and 47%, respectively, from that reported in 1983. Three producers shipped iron ore in 1984 from Eureka, Churchill, and Pershing Counties. Nevada-Barth Corp.'s Eureka County operation was the State's largest shipper.

**Lead.**—Small amounts of lead were recovered during the year as byproducts of gold and silver production from Churchill and Mineral Counties. Byproduct lead was also reported from Anaconda Minerals' Nevada Moly operation in Nye County.

**Mercury.**—Nevada accounted for all of the mercury production reported in the Nation during 1984. The McDermitt Mine in Humboldt County, operated by Placer U.S., was the principal producer. Production was 19,048 76-pound flasks, or about 24% less than that of 1983. Smaller amounts of mercury were also produced as a byproduct from gold mining residues at the Carlin and Pinson Mines.

**Molybdenum.**—Nevada's molybdenum production was restricted to operations at Anaconda Minerals' Nevada Moly operations near Tonopah. Kennecott's Ely and McGill operations in White Pine County remained closed during the year. Exxon Minerals Co. continued with development plans for its Mount Hope molybdenum project in Eureka County, but stretched out plans for completion owing to unfavorable market conditions.

**Silver.**—Nevada ranked second among the Nation's silver producers in 1984. Production of nearly 6.5 million troy ounces of silver was 25% more than that of 1983, although value decreased to $52.7 million owing to lower prices during the year.

NERCO Minerals Co. announced the acquisition of a 50% nonoperating interest in the Taylor silver mine in White Pine County. The mine will be a joint venture between NERCO and Silver King Mines Inc. with Silver King continuing as mine operator.

In October, Asamera Minerals (U.S.) Inc. reached full production capacity of 350 tons per day at the Gooseberry underground silver-gold mine in Storey County. Pacific Silver continued exploration at the Buckskin Mine in Douglas County.

Mount Hope Mining Corp. reopened the Lucky Boy Mine near Hawthorne for silver exploration. The Wonder Mine near Fallon began shipments in April. Belmont Resources Inc. began silver leaching operations at its Silver Center Mine east of Fallon. MNR Reprocessing Inc., Toronto, Ontario, Canada, operated a plant north of Tonopah to reprocess tailings from an old silver mine; the plant was shut down late in the year because of declining silver prices.

**Titanium.**—Titanium Metals Corp. of America (TMCA) produced titanium metal sponge and ingot from imported rutile concentrate at its Henderson plant. TMCA is the largest U.S. titanium metal producer with an annual capacity of about 15,000 tons of sponge and 17,000 tons of ingot.

**Tungsten.**—Most Nevada tungsten operations were closed during 1984. These included the Emerson Mine and mill of Union Carbide Corp. at Tempiute in Lincoln County, and General Electric Co.'s Springer Mine, mill, and ammonium paratungstate plant in Pershing County. The Geo-A tungsten mine near Wells in Elko County shipped concentrates to the Umetco Minerals Co. plant in California.

## NONMETALS

**Barite.**—Nevada continued to be the Nation's leading producer of primary barite despite a 7% decrease to 615,000 short tons in 1984. The continuing downturn in oil well drilling left many Nevada barite producers with excess inventories. Cutbacks in domestic mine production and grinding plant activities still persisted throughout the State.

Dresser Industries Inc., Magobar Minerals Div.'s Greystone Mine and mill in Lander County, and NL Industries Inc., Baroid Div.'s Queen Lode and Sage Hen Mines in Elko County were the largest producers. Additional production was reported from six mines in Lander County and two mines in Nye County. Circle A Mining Co. constructed a jig plant north of Wells and began production at midyear. Eisenmann Chemical Co., a subsidiary of Newpark Resources Inc., reopened its Lakes Mountain jig plant for a 3-month period.

Nevada continued to produce about 80% of the total U.S. output of barite. A comprehensive report on Nevada barite (Bulletin 98) was published by the Nevada Bureau of Mines and Geology in 1984.

**Cement.**—Nevada Cement Co. continued to produce from a plant near Fernley in Lyon County, utilizing freshwater limestone mined nearby and clay mined in central Washoe County. Nevada Cement operates the only cement plant in Nevada. The company began operation of a 45- to 48-car cement unit train between its plant at Fernley and its distribution terminal near Sacramento, CA, in February.

**Clays.**—The largest producer of Nevada clays, Industrial Mineral Ventures Inc., mined and processed sepiolite and bentonite in southern Nye County. Hectorite from California and bentonite from Wyoming were also processed at the plant to make high-value organoclad clays.

**Diatomite.**—Three companies produced diatomite from Miocene or Pliocene freshwater lake deposits. Eagle-Picher Industries Inc. was the State's largest producer from properties in Lyon, Pershing, and Storey Counties. Grefco Inc. in Esmeralda County and Cyprus Diatomite Co. in Churchill County also produced diatomite during the year, resulting in Nevada again becoming the second largest diatomite producing State in 1984.

**Fluorspar.**—Metallurgical-grade fluorspar from the Daisy Mine in Nye County was shipped to steel plants in California.

**Gem Stones.**—An estimated $1.3 million value of gem stones was produced. Turquoise and opals were the most sought after gems.

**Gypsum.**—Continuing improvements in building and construction activities in the

West resulted in an increase in Nevada's gypsum production for the second year. Crude gypsum mined increased 19% to 1.2 million short tons, and calcined gypsum produced increased 16% to 779,000 short tons. Production was reported from four companies in Clark, Lyon, and Pershing Counties.

**Lime.**—Genstar Lime Co. mined carbonate rocks at three locations in Clark County—dolomite at Sloan, and limestone at Apex and Henderson. A deposit of dolomite near the Apex plant was being explored late in the year.

Marblehead Lime Co. opened a large limestone mine near Pilot Sighting in eastern Elko County. The crushed rock was hauled by truck to the company's lime plant in Utah.

**Lithium Compounds.**—Foote Mineral Co., a subsidiary of Newmont Mining, was the State's sole producer of lithium compounds, which were recovered from brines in Esmeralda County. Lithium carbonate was produced by solar evaporation and chemical processing of lithium-rich brines pumped from beneath the Silver Peak dry lake.

**Magnesite.**—Basic Inc.'s magnesite operation at Gabbs in Nye County continued to operate at a low and intermittent level. It remained the only magnesite producer in the United States, with output and value slightly below that of 1983. The material was used in refractories, in steel, and to make magnesium oxide.

**Perlite.**—Nevada's perlite production in 1984 came solely from the United States Gypsum Co., which sold expanded perlite from its Empire plant in Washoe County.

**Salt.**—The Huck Salt Co. operation in Churchill County, owned by Leslie Salt Co., was the only reported 1984 salt producer in the State.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. The data for odd-numbered years are based on annual company estimates made before yearend.

Sand and gravel for construction, used primarily in concrete aggregate, asphaltic concrete, road base and coverings, and as fill, increased 36% in quantity produced and 75% in value from that of 1982, the last year in which surveys were conducted. Production in 1984 was reported from 62 operations throughout the State, with 3 companies reporting more than 600,000 short tons and 17 companies reporting less than 25,000 short tons. The major portion of the production was from Clark and Washoe Counties. Douglas, Elko, and Lyon Counties also had production of more than 300,000 short tons.

*Industrial.*—Simplot Industries Inc.'s Silica Products Div.'s plant in Clark County was the only reported producer of industrial sand during 1984. Silica sand was used for containers, flux, molding, and silicon carbide production. Production in 1984 decreased 45% and value decreased 3% from that reported in 1982.

**Table 7.—Nevada: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 1,378 | $3,951 | $2.87 |
| Plaster and gunite sands | 43 | 138 | 3.24 |
| Concrete products | 249 | 1,183 | 4.76 |
| Asphaltic concrete | 1,375 | 2,774 | 2.02 |
| Road base and coverings | 1,550 | 3,618 | 2.33 |
| Fill | 291 | 755 | 2.60 |
| Snow and ice control | 78 | 229 | 2.93 |
| Other[1] | 3,239 | 7,858 | 2.43 |
| Total[2] or average | 8,202 | 20,505 | 2.50 |

[1] Includes other unspecified uses.

[2] Data may not add to totals shown because of independent rounding.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

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[1] State Mineral Officer, Bureau of Mines, Reno, NV.

[2] Director and State geologist, Nevada Bureau of Mines and Geology, Reno, NV.

## Table 8.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Barite: | | | |
| Dresser Industries Inc., Magobar Minerals Div. | Box 370<br>Battle Mountain, NV 89820 | Surface mine and mill | Lander. |
| NL Industries Inc., Baroid Div | Box 414<br>Battle Mountain, NV 89820 | do | Elko. |
| Cement: | | | |
| Centex Corp., Nevada Cement Co | Box 840<br>Fernley, NV 89408 | Plant | Lyon. |
| Clays: | | | |
| Industrial Mineral Ventures Inc | 1800 East Sahara Ave.<br>Suite 107<br>Las Vegas, NV 89104 | Surface mine and mill | Nye. |
| Copper: | | | |
| The Anaconda Minerals Co | Box 1268<br>Tonopah, NV 89049 | do | Do. |
| Duval Corp | Box 451<br>Battle Mountain, NV 89820 | do | Lander. |
| Diatomite: | | | |
| Eagle-Picher Industries Inc., Minerals Div. | Box 12130<br>Reno, NV 89510 | Surface mine and plants. | Lyon, Pershing, Storey. |
| Grefco Inc., Dicolite Div | Box 288<br>Mina, NV 89422 | Surface mine and plant | Esmeralda. |
| Fluorspar: | | | |
| J. Irving Crowell, Jr., & Son | Box 96<br>Beatty, NV 89003 | Underground mine | Nye. |
| Gold: | | | |
| Carlin Gold Mining Co., a subsidiary of Newmont Mining Corp. | Box 979<br>Carlin, NV 89822 | Surface mine, mill, refinery. | Eureka. |
| Copper Range Co., Smokey Valley Mining Div. | Box 480<br>Round Mountain, NV 89045 | do | Nye. |
| Freeport Gold Co., Joint Venture | Mountain City Star Route<br>Elko, NV 89801 | Surface mine and mill | Elko. |
| Gypsum: | | | |
| Genstar Building Products Co | Box 2580<br>Irving, TX 75061 | Surface mine and plant | Clark. |
| Pacific Coast Bldg. Products Inc | Box 405<br>37851 Cherry St.<br>Newark, CA 94560 | do | Do. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Pershing. |
| Iron Ore: | | | |
| Nevada-Barth Corp., Barth Div | Box 425<br>Carlin, NV 89822 | do | Eureka. |
| Lime: | | | |
| Genstar Lime Co | 215 Market St., Suite 1000<br>San Francisco, CA 94105 | do | Clark. |
| Lithium compounds: | | | |
| Foote Mineral Co | Route 100<br>Exton, PA 19341 | Dry lake brines and plant. | Esmeralda. |
| Magnesite: | | | |
| Basic Inc | 845 Hanna Bldg.<br>Cleveland, OH 44115 | Surface mine and mill | Nye. |
| Mercury: | | | |
| Placer U.S. Inc., McDermitt Joint Venture. | Box 497<br>McDermitt, NV 89421 | do | Humboldt. |
| Molybdenum: | | | |
| The Anaconda Minerals Co | Box 1268<br>Tonopah, NV 89049 | do | Nye. |
| Perlite: | | | |
| United States Gypsum Co | Empire, NV 89405 | Plant | Washoe. |
| Salt: | | | |
| Leslie Salt Co., Huck Salt Co | 895 Harrigan Rd.<br>Fallon, NV 89406 | Solar evaporation plant. | Churchill. |
| Sand and gravel (construction): | | | |
| ARC Materials Corp., WMK Transit Mix. | Box 14697<br>Las Vegas, NV 89114 | Pits and mills | Clark. |
| Robert L. Helms Construction Co | Drawer 608<br>Sparks, NV 89432-0608 | Pits and mill | Lander and Washoe. |
| Industrial Construction Inc., Bonanza Materials Inc. | 565 Lalif Rd.<br>Henderson, NV 89015 | Pit and plant | Clark. |
| Las Vegas Building Materials Inc | Box 530<br>Las Vegas, NV 89101 | Pit | Do. |
| Las Vegas Paving Corp | 1770 South Industrial Rd.<br>Las Vegas, NV 89102 | Pit | Do. |
| Rilite Aggregate Co. Inc | Box 11767<br>Reno, NV 89510 | Pit and mill | Washoe. |
| Southern Nevada Paving Inc | 3555 Polaris Ave.<br>Las Vegas, NV 89103 | Pits and mill | Clark. |
| Stewart Bros. Co | Box 42755<br>Las Vegas, NV 89116 | Pit and mill | Do. |
| Wells Cargo Inc | Box 14037<br>Las Vegas, NV 89114 | do | Do. |

Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Silver: | | | |
| NERCO Minerals Co | Box 1246<br>Hawthorne, NV 89415 | Surface mine and plant | Mineral. |
| Silver King Mines Inc | Box 324<br>East Ely, NV 89315 | do | White Pine. |
| Sunshine Mining Co | Box 97<br>Silverpeak, NV 89047 | Underground mine and mill. | Esmeralda. |
| Stone (1983): | | | |
| Centex Corp., Nevada Cement Co | Box 840<br>Fernley, NV 89408 | Quarry | Lyon. |
| Genstar Lime Co | 901 Mariner's Blvd.<br>Suite 425<br>San Mateo, CA 94404 | Quarries | Clark. |
| Glass Mountain Block Inc | 355 Gregg St.<br>Sparks, NV 89431 | Quarry | Storey. |

# The Mineral Industry of New Hampshire

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New Hampshire Department of Resources and Economic Development for collecting information on all nonfuel minerals.**

**By L. J. Prosser, Jr.,[1] and Lincoln R. Page[2]**

The value of nonfuel mineral production in New Hampshire in 1984 was $23.1 million, an increase of $4 million compared with the 1983 total. This was the result of improved conditions in the construction industry and, thus, a greater demand for sand and gravel. With the signing of the New Hampshire Wilderness Bill, an additional 77,000 acres of the White Mountain National Forest (WMNF) were designated as wilderness.

**Table 1.—Nonfuel mineral production in New Hampshire[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Sand and gravel (construction) thousand short tons | [e]4,000 | [e]$12,100 | 5,637 | $16,054 |
| Stone: | | | | |
| Crushed do | 946 | 2,853 | [e]850 | [e]2,700 |
| Dimension do | 58 | 4,032 | [e]59 | [e]4,198 |
| Combined value of other nonmetals | XX | 101 | XX | 160 |
| Total | XX | 19,086 | XX | 23,112 |

[e] Estimated. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

### Table 2.—Value of nonfuel mineral production in New Hampshire, by county

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Belknap | W | (1) | |
| Carroll | $2,924 | (1) | |
| Cheshire | W | W | Stone (crushed). |
| Coos | 566 | W | Stone (dimension). |
| Grafton | 460 | W | Stone (crushed). |
| Hillsborough | 2,486 | W | Stone (dimension). |
| Merrimack | 2,327 | W | Stone (dimension), stone (crushed). |
| Rockingham | 928 | W | Stone (crushed). |
| Strafford | W | W | Clays. |
| Sullivan | 701 | (1) | |
| Undistributed[2] | 2,302 | $6,985 | |
| Sand and gravel (construction) | XX | [e]12,100 | |
| Stone: | | | |
| Crushed | [e]3,100 | XX | |
| Dimension | [r] [e]3,593 | XX | |
| Total | [r]19,387 | [3]19,086 | |

[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

(1) Construction sand and gravel was produced; data were not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[2] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data do not add to total shown because of independent rounding.

### Table 3.—Indicators of New Hampshire business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 948 | 958 | 977 |
| Total civilian labor force | do | 486 | 500 | 520 |
| Unemployment | do | 36 | 27 | 22 |
| Employment (nonagricultural): | | | | |
| Mining total | do | .4 | .4 | .4 |
| Nonmetallic minerals except fuels[1] | do | .4 | .4 | NA |
| Manufacturing total | do | 111.7 | 113.3 | 123.3 |
| Primary metal industries | do | 3.7 | 3.9 | 4.6 |
| Stone, clay, and glass products | do | 2.6 | 2.5 | 2.9 |
| Chemicals and allied products[1] | do | .9 | .9 | NA |
| Construction | do | 22.8 | 24.4 | 25.5 |
| Transportation and public utilities | do | 14.7 | 15.0 | 15.1 |
| Wholesale and retail trade | do | 88.4 | 94.1 | 104.5 |
| Finance, insurance, real estate | do | 21.0 | 21.6 | 23.5 |
| Services | do | 79.5 | 84.6 | 91.1 |
| Government and government enterprises | do | 55.9 | 56.1 | 57.5 |
| Total | do | 394.4 | 409.5 | 440.9 |
| Personal income: | | | | |
| Total | millions | $10,469 | $11,528 | $12,885 |
| Per capita | | $11,044 | $12,028 | $13,192 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.6 | 40.5 | 41.0 |
| Total average hourly earnings, production workers | | $6.94 | $7.42 | $7.85 |
| Earnings by industry: | | | | |
| Farm income | millions | $31 | $30 | $30 |
| Nonfarm | do | $6,868 | $7,702 | $8,677 |
| Mining total | do | $7 | $8 | $9 |
| Nonmetallic minerals except fuels | do | $7 | $8 | $9 |
| Manufacturing total | do | $2,261 | $2,486 | $2,881 |
| Primary metal industries | do | $91 | $91 | $100 |
| Stone, clay, and glass products | do | $50 | $55 | $67 |
| Chemicals and allied products | do | $21 | $22 | $27 |
| Construction | do | $560 | $657 | $649 |
| Transportation and public utilities | do | $380 | $425 | $457 |
| Wholesale and retail trade | do | $1,127 | $1,277 | $1,475 |
| Finance, insurance, real estate | do | $344 | $396 | $467 |
| Services | do | $1,278 | $1,471 | $1,673 |
| Government and government enterprises | do | $889 | $958 | $1,039 |

See footnotes at end of table.

**Table 3.—Indicators of New Hampshire business activity —Continued**

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 4,508 | 7,809 | 9,787 |
| Value of nonresidential construction millions | $142.3 | $275.8 | $266.8 |
| Value of State road contract awards do | $51.4 | $68.0 | $71.5 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 297 | 268 | 329 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $19.4 | $19.1 | $23.1 |
| Value per capita | $25 | $20 | $24 |

[p] Preliminary. [r] Revised. NA Not available.
[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

**Legislation and Government Programs.**—Public Law 98-322 designating 77,000 acres as wilderness in the WMNF was signed by the President on June 19. Lands designated as wilderness are protected and managed by the Federal Government to preserve natural conditions to allow nature to dominate the environment. The wilderness designations in the WMNF essentially preclude mining activity. The 77,000 acres included three areas—one near the Pemigewasset River north of Loon Mountain (45,000 acres), the Sandwich Range (25,000 acres), and the Dry River Extension (7,000 acres). With these lands, a total of 102,000 acres of the 751,000-acre WMNF are wilderness.

In October, the Draft Forest Plan and the Environmental Impact Statement for the WMNF were released for public comment. These reports provide a framework for U.S. Forest Service management of the forest lands for a 10-year period. Potential for mineral development in the forest was considered low.[3]

New Hampshire, through the Office of the State Geologist, continued cooperative projects with the U.S. Bureau of Mines, U.S. Geological Survey (USGS), and Minerals Management Service relating to the geology and mineral resources of the State. A cooperative surficial mapping project with the USGS continued; the Derry and Candia 7-1/2-minute quadrangles were completed and work in the Merrimack Valley was begun. A preliminary geologic map of the Sherbrooke-Lewiston 2-minute quadrangle (1:250,000), which covers portions of New Hampshire along with parts of Maine and Vermont, was completed by the USGS as part of the Conterminous United States Mineral Appraisal Program (CUSMAP).[4] This map was part of a report for the area that also included sections on resources associated with Jurassic plutons, uranium in peat, historical data of past mineral production 1900-77, and principles and applications of mineral resource assessment.[5] Also, as part of the CUSMAP program, initial geochemical exploration in the Glens Falls 2-minute quadrangle resulted in identification of several anomalous zones. In New Hampshire, these anomalies included scheelite-gold-bismuth-silver related to sources in the Ammonusuc volcanics, and tungsten-tin-beryllium in granites. Further investigations were planned in these zones in 1985. Also published by the USGS in 1984 was a map on the mineral resource potential of the wilderness and roadless areas of the WMNF.[6]

A small research project on sand and gravel deposits on the Continental Shelf along the State's coastline was funded by the Minerals Management Service. In 1984, samples were obtained by vibracoring to confirm the seismic units previously recognized along the shelf. Analyses of the samples were to be completed in 1985.

A cooperative program for collection of data on mineral production in the State continued with the U.S. Bureau of Mines. The data provide a historical perspective of trends in the State's mining industry.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Clays.**—One company mined a small amount of clay for use in brick manufacture in Gonic, Strafford County. As a small-scale producer and because of higher fuel costs in the Northeast, operations of this type rely on restoration projects for a majority of their sales. Modern facilities in the Southeast usually produce a standard colored brick while the small northeastern operations often manufacture a multicolored brick compatible with older structures undergoing renovation.

**Gem Stones.**—With a long history of past mining operations, New Hampshire remains an area of interest to rockhounds and mineral collectors. One site often investigated by collectors is the Ruggles Mine in Grafton, which opened in 1803 and was the first pegmatite mining operation in New England.[7]

**Gypsum (Calcined).**—National Gypsum Co., Portsmouth, Rockingham County, imported crude gypsum from company-owned mines in Nova Scotia, Canada, for the manufacture of gypsum wallboard. A small quantity of vermiculite was also used by National Gypsum in the production of a fire-resistant wallboard. The company was one of the two active gypsum calciners in New England; the other, United States Gypsum Co., operated a plant in Massachusetts.

**Sand and Gravel.**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production increased in 1984, ending a period of 5 consecutive years of decline. The positive effect on sand and gravel output resulting from improved conditions in the construction industry is shown below:

| Year | Number of deposits | Quantity (thousand short tons) | Value per ton | Housing starts |
|---|---|---|---|---|
| 1980 | 48 | 6,334 | $2.50 | 5,278 |
| 1982 | 38 | 4,332 | 2.91 | 4,508 |
| 1984 | 57 | 5,637 | 2.85 | 9,787 |

In 1984, about 1.3 million tons of sand and gravel, or nearly 25% of the State total, was produced in Merrimack County in the south-central part of the State; in 1982, about 898,000 tons was produced. The increased output in 1984 reflected the economic growth of that area and, in particular, in Manchester, the State's largest city.

**Table 4.—New Hampshire: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 942 | $3,543 | $3.76 |
| Plaster and gunite sands | W | W | 3.80 |
| Concrete products | W | W | 2.28 |
| Asphaltic concrete | 523 | 1,336 | 2.55 |
| Road base and coverings[1] | 893 | 2,740 | 3.07 |
| Fill | 171 | 357 | 2.09 |
| Snow and ice control | 87 | 196 | 2.24 |
| Other | 3,020 | 7,881 | 2.61 |
| Total[2] or average | 5,637 | 16,054 | 2.85 |

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1] Includes road and other stabilization (cement).
[2] Data do not add to totals shown because of independent rounding.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—The estimated output of 850,000 tons was 10% below the 1983 level, but well above 1982 production of 600,000 tons. Traprock was mined in four counties and granite in one county. Primary uses were for concrete aggregate and bituminous aggregate.

*Dimension.*—Output remained about the same in 1984. Dimension granite was mined by four companies with each operating one quarry. Leading uses for the granite were for rough blocks, curbing, and irregular-shaped stone.

J. Swenson Granite Co., Concord, one of the State's four producers in a partnership with a group of investors, purchased Rock of Ages Corp. from Nortek Inc. of Providence, RI, for an estimated $20 million. Rock of Ages, one of the Nation's leading granite producers, operated three granite quarries in Vermont and one in New Hampshire in 1984.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] State geologist, New Hampshire Department of Resources and Economic Development, Durham, NH.

[3] Forest Service, U.S. Department of Agriculture. Draft Environment Impact Statement, Land and Resource Management Plan White Mountain National Forest Abstract. P. 2. For information contact White Mountain National Forest, Box 638, Laconia, NH 03247; 603-524-6450.

[4] Moench, R. H. (ed.) Geologic Map of the Sherbrooke-Lewiston Area, Maine, New Hampshire, and Vermont. U.S. Geol. Surv. Open-File Rep. 84-650, map scale 1:250,000, 1984.

[5] Cameron, C. C. Peat Resources and Preliminary Evaluation of Uranium Resources in Holocene Organic Deposits as of 1984, Lewiston and Sherbrooke 1° by 2° Sheets, Northern New England. U.S. Geol. Surv. Open-File Rep. 84-559, 1984.

Bawiec, W. J. Mineral Production (1900-1977) of the Sherbrooke-Lewiston 1° by 2° Quadrangle; Maine, New Hampshire, and Vermont. U.S. Geol. Surv. Open-File Rep. 84-752, 1984.

[6] Moench, R. H., et al. Mineral Resource Potential Map of the Wilderness and Roadless Areas of the White Mountain National Forest; Coos, Grafton, and Carroll Counties, New Hampshire. U.S. Geol. Surv. Map MF-1594-B, scale 1:125,000, 1984.

[7] Cameron, E. N., D. M. Larrabee, A. H. McNair, J. J. Page, G. W. Stewart, and V. E. Shainin. Pegmatite Investigations, 1942-45, in New England. U.S. Geol. Surv. Prof. Paper 255, 1954, p. 7.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays: | | | |
| Kane-Gonic Brick Corp | Gonic, NH 03867 | Pit | Strafford. |
| Gypsum (calcined): | | | |
| National Gypsum Co | 4500 Lincoln Plaza<br>Dallas, TX 75201 | Plant | Rockingham. |
| Sand and gravel: | | | |
| Granite State Concrete Inc | Box 185<br>Milford, NH 03055 | Pit | Hillsborough. |
| Manchester Sand & Gravel & Cement Co. Inc. | Box 415<br>Hooksett, NH 03106 | Pit | Merrimack. |
| Ossipee Aggregates Corp | Box 134<br>Ossipee, NH 03864 | Pit | Carroll. |
| Plourde Sand & Gravel Co. Inc | Suncook, NH 03275 | Pit and plant | Merrimack. |
| A. Whitcomb Inc | Lancaster Rd.<br>Gorham, NH 03581 | Pits | Belknap,<br>Carroll,<br>Cheshire,<br>Coos,<br>Grafton. |
| F. W. Whitcomb Construction Corp | Box 429<br>Bellows Falls, VT 05101 | Pit | Cheshire. |
| Stone: | | | |
| Crushed: | | | |
| Boston S&G Cook Concrete Co | 150 Causeway St.<br>Boston, MA 02114 | Quarry | Merrimack. |
| Iafolla Industries Inc | Peverly Hill Rd.<br>Portsmouth, NH 03801 | do | Rockingham. |
| Lebanon Crushed Stone Inc | Plainfield Rd.<br>West Lebanon, NH 03784 | do | Grafton. |
| Dimension: | | | |
| Kitledge Granite Corp | Armory Rd.<br>Milford, NH 03055 | do | Hillsborough. |
| Maine-New Hampshire Granite Corp. | Box 207<br>Milford, NH 03055 | do | Do. |
| J. Swenson Granite Co | North State St.<br>Concord, NH 03301 | do | Merrimack. |

# The Mineral Industry of New Jersey

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Division of Water Resources, New Jersey Department of Environmental Protection, for collecting information on all nonfuel minerals.**

### By Donald K. Harrison[1]

The value of New Jersey's nonfuel mineral production in 1984 was $156.2 million, a $1.6 million increase over that of 1983. Crushed stone continued to be the leading nonfuel mineral produced, accounting for nearly one-half of the State's total value. Other minerals produced, in order of descending value, included industrial sand, construction sand and gravel, zinc, greensand, clays, dimension stone, and peat. Mineral commodities processed or manufactured included aluminum, copper, ferroalloys, gypsum, iodine, iron oxide pigments, perlite, quartz crystal, selenium, talc, and vermiculite. Elemental sulfur was recoverod as a byproduct at four oil refineries.

Nationally, New Jersey ranked 35th in the value of nonfuel minerals produced. The State ranked third in output of industrial sand, fifth in zinc production, and sixth of 29 States that exfoliated vermiculite.

**Table 1.—Nonfuel mineral production in New Jersey[1]**

| Mineral | | 1983 | | 1984 | |
|---|---|---|---|---|---|
| | | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays | thousand short tons | 62 | $596 | 62 | $611 |
| Gem stones | | NA | 1 | NA | 1 |
| Peat | thousand short tons | W | W | 5 | 128 |
| Sand and gravel: | | | | | |
| Construction | do | $^e$10,800 | $^e$34,300 | 9,545 | 31,878 |
| Industrial | do | 2,386 | 31,819 | 2,712 | 32,287 |
| Stone (crushed) | do | 12,301 | 70,421 | $^e$13,500 | $^e$75,000 |
| Zinc (recoverable content of ores, etc.) | metric tons | 16,475 | 15,083 | W | W |
| Combined value of magnesium compounds (1983), greensand, stone (dimension), and values indicated by symbol W | | XX | 2,445 | XX | 16,331 |
| Total | | XX | 154,615 | XX | 156,236 |

$^e$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in New Jersey, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Atlantic | W | (2) | |
| Bergen | $1,263 | (2) | |
| Burlington | W | (2) | |
| Camden | 2,652 | (2) | |
| Cape May | W | (2) | Magnesium compounds. |
| Cumberland | W | W | Sand (industrial), clays. |
| Essex | (3) | W | Stone (crushed). |
| Gloucester | W | W | Greensand, sand (industrial). |
| Hudson | (3) | -- | |
| Hunterdon | (3) | W | Stone (crushed), stone (dimension). |
| Mercer | (3) | W | Stone (crushed). |
| Middlesex | W | W | Sand (industrial). |
| Monmouth | 1,648 | (2) | |
| Morris | 4,736 | $6,692 | Stone (crushed). |
| Ocean | W | W | Sand (industrial). |
| Passaic | 1,787 | 10,126 | Stone (crushed). |
| Salem | W | (2) | |
| Somerset | W | 27,300 | Stone (crushed), clays. |
| Sussex | 17,178 | W | Zinc, stone (crushed), peat. |
| Warren | W | W | Peat. |
| Undistributed[4] | r45,268 | 76,197 | |
| Sand and gravel (construction) | XX | e34,300 | |
| Stone: | | | |
| Crushed | e57,800 | XX | |
| Dimension | W | XX | |
| Total | r 5132,333 | 154,615 | |

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for Union County.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of New Jersey business activity

| | | 1982r | 1983 | 1984p |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 7,428 | 7,464 | 7,515 |
| Total civilian labor force | do | 3,619 | 3,678 | 3,829 |
| Unemployment | do | 325 | 288 | 236 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 2.1 | 2.0 | 2.2 |
| Nonmetallic minerals except fuels[2] | do | 1.9 | 1.8 | NA |
| Oil and gas extraction[2] | do | .1 | .1 | NA |
| Manufacturing total | do | 729.7 | 715.1 | 729.4 |
| Primary metal industries | do | 21.8 | 20.7 | 21.7 |
| Stone, clay, and glass products | do | 27.1 | 26.8 | 26.4 |
| Chemicals and allied products | do | 124.5 | 119.1 | 120.7 |
| Petroleum and coal products | do | 11.2 | 10.3 | 10.1 |
| Construction | do | 107.3 | 112.1 | 132.6 |
| Transportation and public utilities | do | 197.1 | 203.0 | 215.9 |
| Wholesale and retail trade | do | 701.2 | 735.3 | 795.9 |
| Finance, insurance, real estate | do | 167.1 | 172.7 | 182.8 |
| Services | do | 662.1 | 701.0 | 754.7 |
| Government and government enterprises | do | 510.6 | 521.2 | 525.3 |
| Total | do | 3,077.2 | 3,162.4 | [3]3,338.7 |
| Personal income: | | | | |
| Total | millions | $97,093 | $104,823 | $116,029 |
| Per capita | | $13,073 | $14,044 | $15,444 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.9 | 40.6 | 41.1 |
| Total average hourly earnings, production workers | | $8.66 | $9.11 | $9.50 |

See footnotes at end of table.

Table 3.—Indicators of New Jersey business activity —Continued

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Earnings by industry: | | | | |
| Farm income | millions | $205 | $194 | $206 |
| Nonfarm | do | $63,881 | $70,032 | $78,127 |
| Mining total | do | $56 | $54 | $62 |
| Nonmetallic minerals except fuels | do | $44 | $45 | $52 |
| Oil and gas extraction | do | $9 | $6 | $7 |
| Manufacturing total | do | $17,429 | $18,783 | $20,269 |
| Primary metal industries | do | $604 | $621 | $666 |
| Stone, clay, and glass products | do | $639 | $657 | $693 |
| Chemicals and allied products | do | $3,795 | $3,910 | $4,240 |
| Petroleum and coal products | do | $518 | $548 | $567 |
| Construction | do | $2,840 | $3,209 | $3,997 |
| Transportation and public utilities | do | $5,754 | $6,153 | $7,015 |
| Wholesale and retail trade | do | $11,182 | $12,348 | $14,077 |
| Finance, insurance, real estate | do | $3,307 | $3,883 | $4,378 |
| Services | do | $13,107 | $15,051 | $16,919 |
| Government and government enterprises | do | $9,685 | $10,348 | $11,173 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 21,327 | 36,077 | 43,024 |
| Value of nonresidential construction | millions | $1,422.8 | $1,344.8 | $1,792.4 |
| Value of State road contract awards | do | $188.0 | $208.0 | $244.3 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 1,288 | 1,393 | 1,740 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $132.3 | $154.6 | $156.2 |
| Value per capita | | $18 | $21 | $21 |

[p]Preliminary. [r]Revised. NA Not available.

[1]Bureau of Labor Statistics, U.S. Department of Labor; totals do not add because of inclusion of data from other sources.

[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

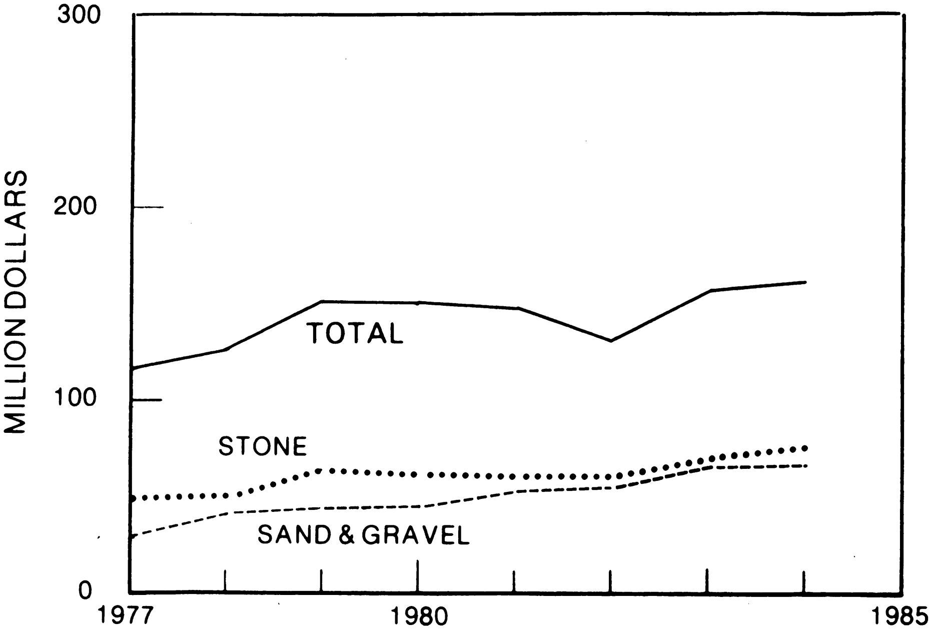

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in New Jersey.

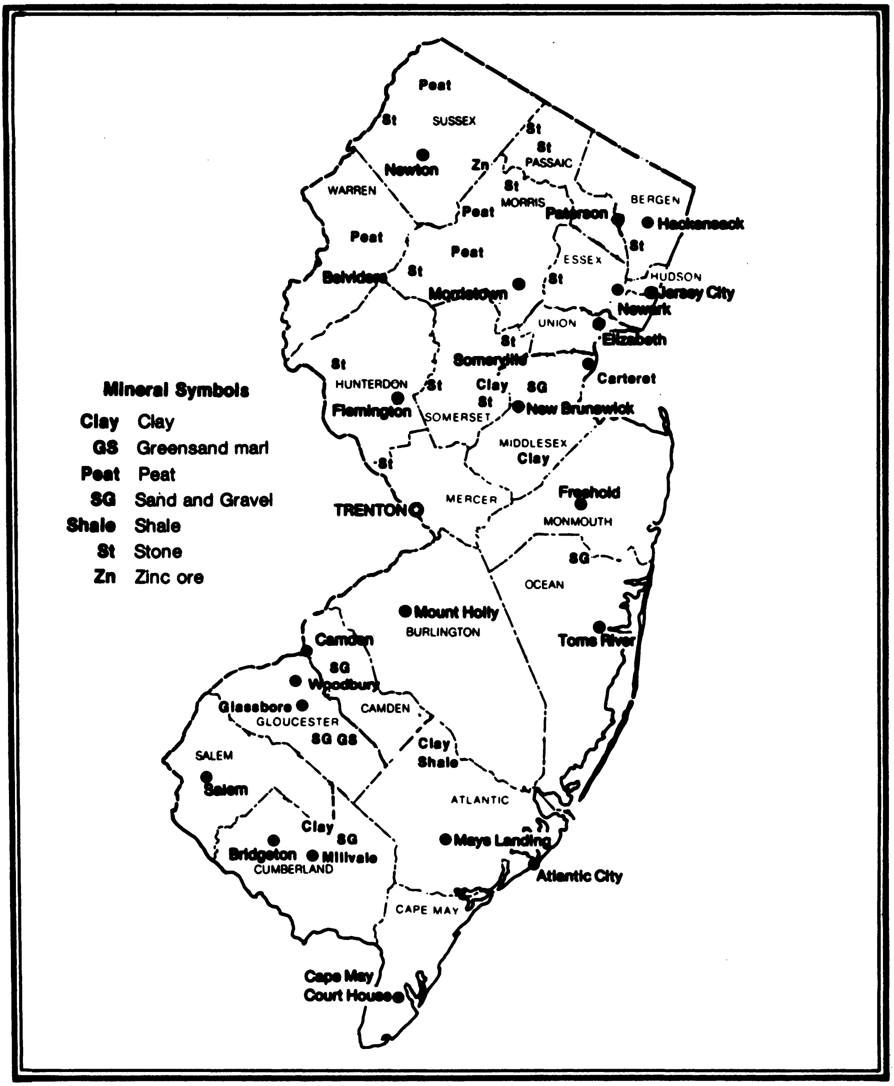

Figure 2.—Principal mineral producing localities in New Jersey.

**Trends and Developments.**—Two concerns in the State during 1984 were the reported discovery of rich uranium deposits several years ago and the effects of acid rain on the ecosystem. In the case of the uranium deposits identified, the State, in 1981, imposed a 7-year moratorium on all uranium activities until 1988. In the interim, a commission was established to examine the ramifications of uranium mining. The commission was to consider the potential for new jobs, new industries created, and increased revenue for the State. These economic issues will be weighed against the potential health and environmental dangers posed in every step of the process: exploration, mining, milling, transportation, uses, and disposal. Counties identified with promising deposits included Sussex, Passaic, Warren, Hunterdon, Morris, and Bergen.

In an effort to better understand the effects of acid rain on the environment, the New Jersey Department of Environmental Protection (DEP) funded four acid rain research projects in the State utilizing a special $100,000 State legislative appropriation and matching Federal funds. The first project, in the New Jersey Pinelands, concerned the role of acid deposition in the acidification of streams in the region. In this project, the U.S. Geological Survey (USGS) is conducting the research. The Pinelands region is a major source of potable water in the State and the composition of the rocks and soil in the area makes it especially susceptible to the effects of acid rain. Two other projects, coordinated by Rutgers University faculty, concern the study of whether acid deposition affects the movement of toxic metals from soils into the lakes and fish, and how acid deposition affects the growth rate of soybeans—one of New Jersey's principal crops. The fourth project, under the direction of faculty from the New Jersey Institute of Technology, concerns laboratory studies of the effects of acid deposition on common building and construction materials, such as aluminum, cast iron, copper, and steel.

**Legislation and Government Programs.**—In February, Assembly Bill 794, the Beverage Container Redemption and Recycling Act, was reintroduced. The bill, opposed by the State's glass and industrial sand producers, would place a 10-cent deposit on all cans and bottle containers. At yearend, the bill was still in the Agricultural and Environmental Committee with voting by the State Assembly expected in early 1985. New Jersey legislators defeated a similar bottle bill in 1983. The State's glass industry, which has sustained recent losses, has opposed the legislation. In 1984, New Jersey was the Nation's third leading industrial sand producer, primarily used for the manufacture of glass products.

During the year, legislation was enacted providing aid to municipalities that lost tax revenues as a result of the 1979 Pinelands Protection Act. The Pinelands Municipal Property Tax Stabilization Act will reimburse pinelands municipalities for losses in tax revenues resulting from vacant land devaluation. The bill was intended to protect property owners from tax increases that would have occurred as a result of vacant land devaluation in their towns. Land use measures within the Pinelands include restrictions on the extractive mineral industries.

In August, State Senate Bill 1635 was signed into law appropriating nearly $10.4 million for specific shore protection projects, which included construction of bulkheads, revetments, and a seawall. The new law (Chapter 103, Public Laws of 1984), which should benefit local construction aggregate producers, provides $5.4 million for State projects and for State matching grants to counties and municipalities; $4.5 million for State loans to counties and municipalities to provide the local share of a State grant; and $0.5 million to the DEP for administrative expenses incurred in implementing the law. The funds were appropriated from the Shore Protection Fund, created under the Shore Protection Bond Act of 1983.

The New Jersey Geological Survey (NJGS) was officially reorganized in November 1984 into three bureaus: the Bureau of Geology and Topography; the Bureau of Ground Water Pollution Analysis; and the Bureau of Ground Water Resources Evaluation. Since its merger with the Bureau of Ground Water Management, the NJGS has expanded its role, especially in the ground water quality and quantity areas. Although not a regulatory agency, the NJGS services all regulators dealing with ground water and geologic problems and receives a large share of its funding from these agencies.

Water, an important resource essential to mining, mineral processing, and reclamation, received additional emphasis in connection with a number of NJGS projects and programs.

In November, the Bureau of Geology and Topography took delivery of a second drill rig and will be receiving a second geophysical logger early in 1985 as part of the NJGS water bond project to revise the State geologic map and evaluate its aquifers. The mapping will be done jointly by the NJGS and USGS under the COGEOMAP program. Full-scale field mapping will begin in the spring of 1985. Several quadrangles had been mapped to established geologic units, and a new 1:100,000 scale USGS base map was nearing completion.

The Bureau of Ground Water Pollution Analysis, which provided hydrogeologic expertise to State regulatory agencies dealing with ground water pollution, continued investigating over 300 ground water pollution cases in the State. In addition, this bureau received additional responsibilities under the new Environmental Clean Up Responsibility Act, which requires industries to obtain certification that the soil and ground water at a site is clean before selling their property.

The Bureau of Ground Water Resources Evaluation was charged with the development and application of hydrogeologic mapping and mathematical, computer, and geophysical techniques to ground water resources evaluation. The Bureau provided information, guidance, and assistance on ground water resources to Federal, State, and local agencies as well as to the general public. During 1984, the Bureau participated in several cooperative programs with the USGS Water Resources Division and conducted an assessment of the State's Quaternary buried valley aquifer systems utilizing geophysical techniques and conventional mapping methods.

During fiscal year 1984, local units of government of the State of New Jersey received $50,312 from the U.S. Department of the Interior as compensation for "payment in lieu of taxes" for the fiscal impacts of certain tax exempt Federal lands within their boundaries. The payments were based on a formula approved by Congress in a 1976 law.

Also during the fiscal year, the U.S. Bureau of Mines had four active contracts in the State, valued at $63,572. The contracts, awarded to Stevens Institute of Technology and three private firms, were for mineral-related studies.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Clays.**—Clay production in New Jersey in 1984 totaled 62,000 short tons valued at $611,000. Both production and value remained essentially the same as that of 1983. Two companies produced clay in the State. New Jersey Shale Brick & Tile Corp. produced common clay and shale at one operation in Somerset County, and The Morie Co. Inc. produced fire clay in Cumberland County. Common clay was used primarily for the manufacture of common brick, and fire clay, primarily for foundry uses.

**Gem Stones.**—Value of gem stones and mineral specimens collected by mineral dealers and amateur collectors in New Jersey was estimated at $1,000 in 1984.

**Greensand.**—Inversand Co., a subsidiary of Hungerford & Terry Inc., near Clayton, Gloucester County, produced greensand in 1984. Deposits of greensand, also known as the mineral glauconite, occur from Sandy Hook south to the Delaware Bay near Salem. Greensand was processed and sold for use mainly as a filtration medium to remove soluble iron and manganese from well waters. A secondary use of the unprocessed material was as a conditioner for organic soils. Glauconite is a hydrous iron potassium silicate containing various amounts of aluminum, magnesium, sodium, and trace elements.

**Gypsum.**—Crude gypsum, imported from Nova Scotia, Canada, was calcined by National Gypsum Co., Burlington County, and Genstar Building Products Co., Camden County. Calcined gypsum production and value increased 19% and 26%, respectively, compared with that of 1983. The calcined gypsum was used primarily in the manufacture of wallboard and industrial and building plasters.

The United States Gypsum Co., which employed more than 350 people at sites throughout New Jersey, was modernizing and expanding its operations in Clark, with the help of a $3.45 million Industrial Development Bond issued by the New Jersey Economic Development Authority. The Clark plant was one of the company's major facilities for the production of paper used at other plants that produce wallboard. As a result of the expanded operations at the Clark plant, the manufacturer of building products expected to bring another 40 permanent jobs and 20 construction jobs to the State.

**Iodine.**—Crude iodine was shipped into New Jersey and utilized by eight companies at nine plants to manufacture various iodine-containing compounds. Iodine compounds were used for laboratory reagents, in pharmaceuticals, specialty organic and inorganic chemicals, and sanitary purposes. The companies that produced iodine-containing compounds were Allied Corp., Morristown; Cooper Chemical Co., Long Valley; Fisher Scientific Co., Fair Lawn; GAF Corp., Linden; Ganes Chemicals Inc., Carlstadt; J. T. Baker Chemical Co., Phillipsburg; Troy Chemical Corp., Newark; and White Chemical Corp., Newark.

**Iron Oxide Pigments.**—Two companies produced finished pigments during the year. Columbian Chemicals Co. operated at Monmouth Junction, Middlesex County, and American Minerals Inc. operated a plant in Camden, Camden County. The American Minerals plant was owned by Combustion Engineering Co. until its sale in January.

**Magnesium Compounds.**—Harbison-Walker Refractories Co.'s plant in Cape May County, closed in October 1983, remained idle throughout 1984.

**Peat.**—In 1984, peat was produced by four companies at four operations in two counties. Sussex County with three operations accounted for most of the production; Warren County had one operation. Production amounted to 5,400 short tons valued at nearly $128,000. Both reed-sedge and humus were produced and were either shipped packaged (43%) or sold in bulk (57%). The peat was used primarily for soil improvement and in potting soil.

**Perlite (Expanded).**—Crude perlite shipped in from out of State was expanded by The Schundler Co. in Edison, Middlesex County. Both production and value were below 1983 levels.

**Quartz Crystal.**—Rowan Industries Inc., Red Bank, Monmouth County, used cultured quartz crystal for the manufacture of electronic components.

**Sand and Gravel.**—*Construction.*— Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output totaled 9.5 million short tons valued at $31.9 million in 1984, a decrease in both quantity and value compared with 1983 estimates. Construction sand and gravel was produced by 63 companies at 74 pits in 15 of the State's 21 counties and was used primarily for concrete aggregate, asphaltic concrete aggregate, fill, and road base and coverings.

**Table 4.—New Jersey: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,774 | $13,721 | $3.64 |
| Plaster and gunite sands | 274 | 1,008 | 3.68 |
| Concrete products | 222 | 791 | 3.56 |
| Asphaltic concrete | 1,559 | 6,144 | 3.94 |
| Road base and coverings[1] | 337 | 1,004 | 2.98 |
| Fill | 409 | 1,187 | 2.90 |
| Snow and ice control | 71 | 298 | 4.21 |
| Other[2] | 2,900 | 7,726 | 2.66 |
| Total[3] or average | 9,545 | 31,878 | 3.34 |

[1] Includes road and other stabilization (cement and lime).
[2] Includes roofing granules and other unspecified uses.
[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—Nationally, New Jersey ranked third in industrial sand production in 1984; 11 companies operated 16 pits in 8 counties and produced 2.7 million short tons valued at $32.3 million. Most of the industrial sand was produced in Cumberland County, which accounted for 75% of the total State output. Other major producing counties were Cape May and Atlantic. Principal uses of industrial sand were for glass products, mold and core, and in sandblasting.

The Morie Co. (formerly Jessie S. Morie & Son Inc.) changed its name near yearend to "reflect the organization's increasing size and scope of mining activities," according to the company. The company, started 50 years ago, had become the Nation's fourth largest sand and gravel producer. Also, during the year, the company acquired the Upper Township Sand and Gravel Co. (UTS&G) in Cape May County for $2.5 million. The Morie Co. entered into an agreement with UTS&G to purchase assets including all of its mineral reserves. Acquisition of UTS&G's 359 acres extended the mineral reserves of The Morie Co.'s New Jersey operation at least 25 years and will allow additional penetration into the sand and gravel market in the southern part of the State.

Owens-Illinois Inc. officially closed its glass container plant in Bridgeton, Cumberland County, in February owing to a consistent lack of profits caused by area overcapacity in the glass container industry; high operating costs, especially for natural gas; and the effect of the forced deposit law in New York and proposed deposit law in New Jersey. The plant, which employed over 600 workers, was operating 2 melting furnaces and 5 forming machines at the time of the shutdown. The primary product was bottles for the soft drink industry.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Estimated crushed stone production totaled 13.5 million short tons valued at $75 million, a 10% increase in output and a 7% increase in value compared with 1983 figures. Major uses of crushed stone were for concrete aggregate, road base, and bituminous aggregate.

In March, the West Amwell Township Committee, Hunterton County, rejected a request by Fort Commanche Inc. for a zoning change to permit a quarry operation at the former Washington Rock Boy Scout camp. The 216-acre property, purchased by the company in 1983 for $600,000, is zoned 3-acre residential. In rejecting the company's request, the Township Committee cited strong local opposition and the Township master plan, which called for keeping the Scout property recreational or 3-acre residential. Near yearend, however, Fort Commanche filed a use variance application with the Township. The controversy was expected to continue into 1985.

Trap Rock Industries Inc.'s Kingston Quarry won the Sentinels of Safety Trophy, mining's most prestigious safety award, for the second time in 4 years. The quarry won the national honor by working 363,293 employee-hours in 1983 without a single lost time injury. The national safety award, which is presented each year to mines in six categories with the best safety records in the country, was cosponsored by the American Mining Congress and the Mine Safety and Health Administration of the U.S. Department of Labor.

**Sulfur (Recovered).**—Elemental sulfur was recovered as a nondiscretionary byproduct at four petroleum refineries in the State. Mobil Oil Corp. and Texaco Inc. each operated a refinery in Gloucester County; Chevron U.S.A. Inc. operated a refinery in Middlesex County; and Exxon Co. U.S.A. operated the Bayway refinery in Union County. In 1984, shipments amounted to 58,136 metric tons valued at $6.6 million. This represents a decrease in quantity and value of 20% and 17%, respectively. Sulfur was used in the manufacture of sulfuric acid, fertilizers, plastics, and other products.

**Talc.**—Talc mined in other States was shipped into New Jersey and processed by Amoco Minerals Co. at a plant in South Plainfield. The talc was used primarily in the manufacture of paper, cosmetics, paint, plastics, and ceramics.

**Vermiculite (Exfoliated).**—Crude vermiculite was shipped into the State and exfoliated by W. R. Grace & Co., Construction Products Div., Trenton, Mercer County, and by Schundler, Edison, Middlesex County. Both output and value rose 15% and 5%, respectively, compared with 1983 levels. Principal uses were for fireproofing, loose fill and block insulation, and as a horticultural agent.

## METALS

**Aluminum.**—A new company, Alumet Smelting Corp. at Newark in Essex County, was formed during the year as a fully integrated secondary smelter. The stock feed for the aluminum scrap will be provided by an adjacent scrapyard. The plant had the capacity to produce about 1,400 metric tons of secondary ingot per year.

**Copper.**—United States Metals Refining Co., a subsidiary of AMAX Inc., Carteret, changed its emphasis from secondary copper smelting and refining and began gearing its operations toward recovering precious metals. The company also announced that it may undertake an $11 million capital investment program in 1985, involving the construction of an electric furnace.

AmRod Corp., a newly formed New Jersey-based company, announced that it would proceed with the construction of a 60,000-metric-ton-per-year state-of-the-art continuous cast copper rod mill, at Port Newark. The facility would be built by Southwire Co., Carrollton, GA, and would include the installation of the Southwire continuous rod system. Along with producing rod, the plant would provide a completely integrated, high-quality copper processing facility. The plant was scheduled to begin operating the first quarter of 1985.

Federated Metals Corp., a subsidiary of ASARCO Incorporated, permanently closed its Newark plant during the year. Citing unprofitability, the company announced that it would no longer produce brass and bronze ingots or copper hardeners. The plant, with nearly 90 employees, had been operating at about 30% capacity.

Copper sulfate continued to be produced by two companies in the State. CP Chemical Inc. operated a plant in Sewaren and Madison Industries Inc. operated a plant in Old Bridge.

**Ferroalloys.**—Shieldalloy Corp., a subsidiary of Metallurg Inc., Newfield, Gloucester County, was the sole producer of ferroalloys in the State. The company, which employed about 250 workers, operated metallothermic furnaces and produced ferroalloys of aluminum, boron, columbium, titanium, and vanadium. The products were used by other companies for the manufacture of cast iron products, auto parts, tool steel, and other products.

**Selenium and Tellurium.**—Primary selenium was produced by the United States Metals Refining Co., a subsidiary of AMAX, at its copper refinery in Carteret, Middlesex County. In 1984, production was sharply curtailed because copper production at the facility had been reduced in December 1983. The facility changed its emphasis to precious metals recovery and was processing little or no primary blister and no longer toll refined anode slimes. Although tellurium production at Carteret ended in 1982, AMAX remained a major consumer of tellurium for use in tellurium copper alloys produced at Carteret.

**Steel.**—New Jersey Steel Corp. at Sayreville was considering a 60% increase in its raw steel output to 400,000 short tons per year from its 1984 full capacity level of 250,000 tons. Capital plans for the expansion, which would be done through modifications to the company's electric arc furnace, were being prepared. New Jersey Steel had been increasing its output steadily since it resumed production in 1981 after lengthy labor disputes closed the plant. Near yearend, the company announced that it would increase productivity of reinforcing bar 60% to 80% as a result of a technology agreement with Co-Steel International Ltd. of Canada. Under the agreement, the minimill had the right to use slit-rolling technology developed in the early 1970's by the Ontario-based steel company. The technology enables bar mills to produce multiple strands of small-diameter rebar from a single billet.

Raritan River Steel Co., Perth Amboy, announced it would spend at least $5 million as part of a continuing $10 million modernization and modification program; $2.2 million of it to raise its rolling speed from 15,000 feet per minute to 20,000 feet per minute, putting it on a par with the world's fastest rolling operations, which are in Japan. Work also would be undertaken to improve Raritan's electric furnace by installing eccentric bottom tapping to make cleaner steel. A $350,000 computer installation was also planned. Expected completion date for the entire project was December 1985.

**Zinc.**—New Jersey ranked fifth among the nine States producing zinc, up from sixth place in 1983. The New Jersey Zinc Co. Inc., the State's only producer, operated the Sterling Mine at Ogdensburg in Sussex County. In terms of total output, the mine was the Nation's ninth leading producer.

In August, 60 miners at the Ogdensburg Mine went on strike, shutting down the 1,850-foot-deep mine. Members of the company's United Steelworkers of America Union at the Depue, IL, zinc dust plant and the Palmerton, PA, plant, where the Sterling zinc ore is processed into zinc oxide, also walked off their jobs after rejecting a proposed contract offer. However, in early September, workers at the three facilities accepted the company's original contract offer and returned to work ending the 18-day strike. During the strike, there had been no disruption of shipments from any of the plants.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays: | | | |
| The Morie Co. Inc.[1] | 1201 North High St.<br>Millville, NJ 08322 | Pit | Cumberland. |
| New Jersey Shale Brick & Tile Corp | Box 490<br>Somerville, NJ 08876 | Pit | Somerset. |
| Greensand: | | | |
| Inversand Co., a subsidiary of Hungerford & Terry Inc. | Box 45<br>Clayton, NJ 08312 | Pit | Gloucester. |
| Gypsum (calcined): | | | |
| Genstar Building Products Co | 1101 South Front St.<br>Camden, NJ 08103 | Plant | Camden. |
| National Gypsum Co | 2001 Rexford Rd.<br>Charlotte, NC 28211 | do | Burlington. |
| Iron oxide pigments: | | | |
| American Minerals Inc | Foot of Jefferson St.<br>Camden, NJ 08101 | do | Camden. |
| Columbian Chemicals Co | Box 37<br>Tulsa, OK 74102 | do | Middlesex. |
| Peat: | | | |
| Glacial Soils Lab | 346 Grand Ave.<br>Englewood, NJ 07631 | Bog | Sussex. |
| Kelsey Humus Co | Kelsey Park<br>Great Meadows, NJ 07838 | Bog | Warren. |
| Netcong Natural Products | R.D. 3, Box 573AA<br>Flemington, NJ 08822 | Bog | Sussex. |
| Stan's Soils | R.D. 2, Box 129<br>Sussex, NJ 07461 | Bog | Do. |
| Perlite (expanded): | | | |
| The Schundler Co.[2] | Box 251<br>Metuchen, NJ 08840 | Plant | Middlesex. |
| Sand and gravel: | | | |
| Construction: | | | |
| Clayton Sand Co | Box 928<br>Lakewood, NJ 08701 | Pit | Ocean. |
| Dallenbach Sand Co. Inc | Box 333<br>Dayton, NJ 08810 | Dredge | Middlesex. |
| Tri-County Asphalt Corp | Box 247, Wheatsworth Rd.<br>Hamburg, NJ 07419 | Pit | Sussex. |
| Tuckahoe Sand & Gravel | Box 248<br>Tuckahoe, NJ 08250 | Dredge | Cape May. |
| Industrial: | | | |
| Pennsylvania Glass Sand Corp | Box 187<br>Berkeley Springs, WV 25411 | Pit | Cumberland. |
| Unimin Corp., Dividing Creek Plant | 258 Elm St.<br>New Canaan, CT 06840 | Pits | De. |
| Whitehead Bros. Co | Box 259, River Rd.<br>Leesburg, NJ 08327 | do | Do. |
| Stone (1983): | | | |
| Granite (crushed and broken): | | | |
| Riverdale Quarry Co | 125 Hamburg Turnpike<br>Riverdale, NJ 07457 | Quarry | Morris. |
| Tri-County Asphalt Corp | Route 15<br>Hopatcong, NJ 07843 | do | Sussex. |
| Traprock (basalt, crushed and broken): | | | |
| Little Ferry Asphalt Corp | 650 Valley Rd.<br>Clifton, NJ 07643 | do | Passaic. |
| Stavola Construction Materials Inc | Box 482<br>Red Bank, NJ 07701 | do | Somerset. |
| Trap Rock Industries Inc | Box 419<br>Kingston, NJ 08528 | Quarries | Hunterdon,<br>Mercer,<br>Somerset. |
| Sulfur (recovered): | | | |
| Chevron U.S.A. Inc | 1200 State St.<br>Perth Amboy, NJ 08861 | Refinery | Middlesex. |
| Exxon Co. U.S.A. | Box 23<br>Linden, NJ 07036 | do | Union. |
| Mobil Oil Corp | Paulsboro, NJ 08066 | do | Gloucester. |
| Texaco Inc | Eagle Point, Box 52332<br>Houston, TX 77052 | do | Do. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 62 Whittemore Ave.<br>Cambridge, MA 02140 | Plant | Mercer. |
| Zinc: | | | |
| The New Jersey Zinc Co. Inc | Sterling Hill Mine<br>Plant St.<br>Ogdensburg, NJ 07439 | Mine | Sussex. |

[1] Also industrial sand and gravel.
[2] Also exfoliated vermiculite.

# The Mineral Industry of New Mexico

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New Mexico Bureau of Mines and Mineral Resources for collecting information on all nonfuel minerals.**

### By Jane P. Ohl[1] and Robert W. Eveleth[2]

The total value of nonfuel minerals produced in New Mexico increased to $619.1 million in 1984 from $517.2 million in 1983, which was still less, however, than the peak of $696 million produced in 1981. New Mexico ranked 10th in the Nation, up from 13th in 1983.

In 1984, 17 nonfuel minerals were produced in the State, 12 nonmetals and 5 metals. Metals accounted for 53% of the total value; nonmetals, 47%. New Mexico ranked first nationwide in production of perlite and potash, and second in copper and pumice. The State also produced noteworthy values of cement, gold, sand and gravel, stone, and silver.

Per capita value of nonfuel mineral production was $435, compared with $98 nationally.

**Table 1.—Nonfuel mineral production in New Mexico[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays ---- thousand short tons-- | 50 | $115 | 67 | $143 |
| Gem stones ---- | NA | 200 | NA | 200 |
| Gypsum ---- thousand short tons-- | 169 | 1,016 | 318 | 1,622 |
| Lead (recoverable content of ores, etc.) ---- metric tons-- | 258 | 123 | -- | -- |
| Lime ---- thousand short tons-- | 17 | W | -- | -- |
| Perlite ---- do---- | 394 | 13,297 | 416 | 14,115 |
| Potassium salts ---- thousand metric tons-- | 1,278 | 174,700 | 1,418 | 204,100 |
| Pumice ---- thousand short tons-- | 110 | 1,070 | 132 | 1,269 |
| Sand and gravel (construction) ---- do---- | $^{e}$7,000 | $^{e}$20,000 | 8,363 | 22,389 |
| Stone: | | | | |
| Crushed ---- do---- | 4,730 | $^{r}$15,118 | $^{e}$4,700 | $^{e}$17,000 |
| Dimension ---- do---- | 18 | 141 | $^{e}$19 | $^{e}$149 |
| Combined value of cement, copper, gold, helium (Grade-A), mica (scrap), molybdenum, salt, silver, tungsten ore and concentrate (1984), and value indicated by symbol W ---- | XX | 291,411 | XX | 358,157 |
| Total ---- | XX | $^{r}$517,191 | XX | 619,144 |

$^{e}$Estimated. $^{r}$Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in New Mexico, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Bernalillo | $28,148 | W | Cement, stone (crushed), clays. |
| Catron | (2) | $17 | Stone (crushed). |
| Chaves | 1,281 | W | Do. |
| Cibola | W | W | Do. |
| Colfax | -- | W | Do. |
| Curry | W | W | Do. |
| De Baca | W | (3) | |
| Dona Ana | 1,004 | W | Stone (crushed), stone (dimension), clays. |
| Eddy | W | W | Potassium salts, salt, stone (crushed). |
| Grant | 119,652 | W | Copper, silver, gold, lime, stone (crushed). |
| Guadalupe | -- | 2 | Stone (crushed). |
| Harding | W | W | Do. |
| Hidalgo | 164 | W | Silver, gold, stone (crushed), clays, lead, copper. |
| Lea | W | W | Stone (crushed), salts. |
| Lincoln | 241 | (3) | |
| Luna | W | W | Clays. |
| McKinley | W | W | Stone (crushed), molybdenum. |
| Otero | 354 | W | Stone (crushed). |
| Quay | -- | 98 | Do. |
| Rio Arriba | W | W | Stone (crushed), pumice. |
| Sandoval | W | W | Silver, gypsum, gold, copper, pumice, lead. |
| San Juan | W | W | Stone (crushed), clays. |
| San Miguel | W | (3) | |
| Santa Fe | 21,740 | W | Gold, pumice, gypsum, stone (crushed). |
| Sierra | 10,765 | 9,360 | Silver, copper, gold, lead. |
| Socorro | W | W | Perlite, stone (crushed), stone (dimension). |
| Taos | 11,934 | 13,649 | Perlite, molybdenum, mica (scrap). |
| Torrance | 90 | W | Stone (crushed). |
| Union | W | W | Do. |
| Valencia | W | W | Perlite, stone (dimension). |
| Undistributed[4] | 220,085 | 474,069 | |
| Sand and gravel (construction) | XX | [e]20,000 | |
| Stone: | | | |
| Crushed | [e]13,700 | XX | |
| Dimension | [r][e]141 | XX | |
| Total[5] | [r]429,303 | 517,191 | |

[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes some stone (crushed), helium (Grade-A), and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of New Mexico business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 1,367 | 1,399 | 1,424 |
| Total civilian labor force | do | 595 | 609 | 628 |
| Unemployment | do | 55 | 62 | 47 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 26.3 | 21.0 | 21.4 |
| Metal mining | do | 5.8 | 4.0 | 3.9 |
| Nonmetallic minerals except fuels[2] | do | 3.1 | 2.4 | NA |
| Coal mining[2] | do | NA | NA | NA |
| Oil and gas extraction | do | 15.4 | 13.0 | 13.3 |
| Manufacturing total | do | 34.1 | 34.4 | 36.6 |
| Primary metal industries[2] | do | 1.3 | 1.3 | NA |
| Stone, clay, and glass products[2] | do | 2.3 | 2.4 | NA |
| Chemicals and allied products[2] | do | .7 | .8 | NA |
| Petroleum and coal products[2] | do | 1.1 | 1.0 | NA |
| Construction | do | 32.1 | 33.7 | 36.3 |
| Transportation and public utilities | do | 29.9 | 29.5 | 29.9 |
| Wholesale and retail trade | do | 108.3 | 110.7 | 117.8 |
| Finance, insurance, real estate | do | 21.9 | 23.2 | 24.5 |
| Services | do | 95.5 | 99.7 | 107.1 |
| Government and government enterprises | do | 125.6 | 127.2 | 129.6 |
| Total[3] | do | 473.6 | 479.5 | 503.2 |
| Personal income: | | | | |
| Total | millions | $12,749 | $13,473 | $14,610 |
| Per capita | | $9,327 | $9,628 | $10,262 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.2 | 39.7 | 39.9 |
| Mining | | 42.2 | 42.4 | 41.9 |
| Total average hourly earnings, production workers | | $7.22 | $7.60 | $7.97 |
| Mining | | $11.15 | $11.21 | $11.49 |
| Earnings by industry: | | | | |
| Farm income | millions | $149 | $154 | $136 |
| Nonfarm | do | $8,905 | $9,458 | $10,294 |
| Mining total | do | $828 | $646 | $700 |
| Metal mining | do | $170 | $124 | $126 |
| Nonmetallic minerals except fuels | do | $80 | $68 | $72 |
| Coal mining | do | W | $73 | $86 |
| Oil and gas extraction | do | W | $381 | $416 |
| Manufacturing total | do | $651 | $718 | $803 |
| Primary metal industries | do | $34 | $38 | $43 |
| Stone, clay, and glass products | do | $46 | $50 | $58 |
| Chemicals and allied products | do | $15 | $17 | $23 |
| Petroleum and coal products | do | $42 | $42 | $43 |
| Construction | do | $665 | $701 | $767 |
| Transportation and public utilities | do | $820 | $865 | $915 |
| Wholesale and retail trade | do | $1,374 | $1,452 | $1,591 |
| Finance, insurance, real estate | do | $333 | $404 | $460 |
| Services | do | $1,717 | $1,934 | $2,149 |
| Government and government enterprises | do | $2,485 | $2,704 | $2,870 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | $8,600 | $10,742 | $16,726 |
| Value of nonresidential construction | millions | $382.1 | $390.1 | $438.2 |
| Value of State road contract awards | do | $150.3 | $164.0 | $220.1 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 553 | 610 | 628 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $429.3 | $517.2 | $619.1 |
| Value per capita | | $314 | $370 | $435 |

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

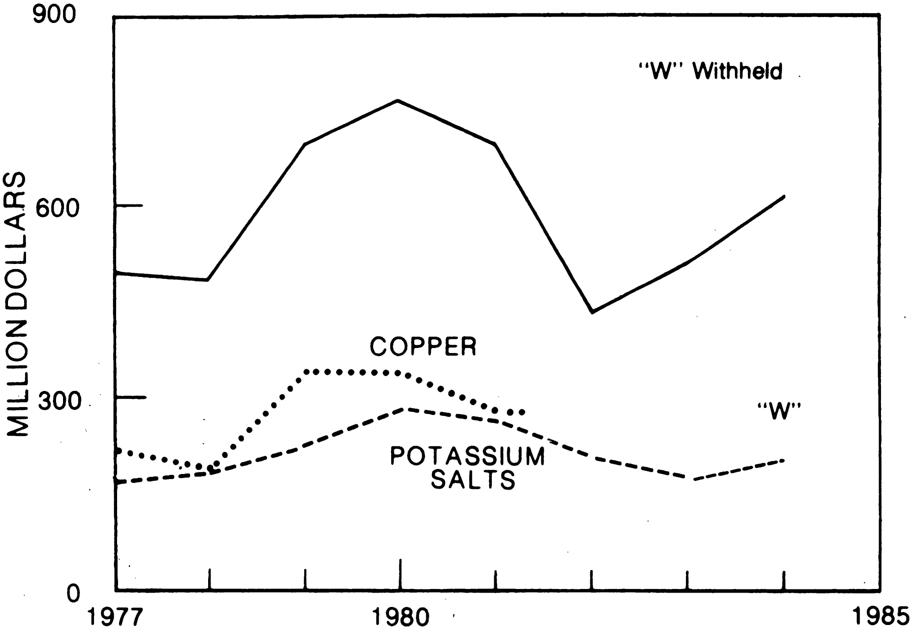

Figure 1.—Value of potassium salts and copper and total value of nonfuel mineral production in New Mexico.

**Trends and Developments.**—The year was very difficult for the minerals industry of New Mexico. All of the base and precious metals producers (excepting perhaps one gold mine), all of the uranium producers, and most of the potash industry operated at or near a reported loss throughout 1984. The situation was little changed at yearend despite large investments in plant improvement, renovations, and new facilities.

National and international conditions contributing to the status of mineral production in New Mexico were (1) competition from foreign producers who were subsidized by their own governments, (2) significantly lower foreign labor costs, (3) little or no pollution-control costs borne or required of foreign producers, (4) often higher grade ores in foreign lands, and (5) a policy of some foreign governments to produce, regardless of world supply and demand, in order to maintain domestic employment.

Also within New Mexico, single access rail freight rates, high fuel and energy costs, and organized labor costs were factors of major interest to mineral producers.

Educational programs and financial aid were offered to laid-off employees in the New Mexico potash industry by International Minerals & Chemical Corp. (IMC), Kerr-McGee Chemical Corp., Ideal Basic Industries Inc.'s subsidiary Potash Co. of America (PCA), AMAX Chemical Corp., and Duval Corp.

Non-Metallic Mining Milling and Manufacturing Inc. asked the city of Lordsburg, Hidalgo County, for an Urban Development Action Grant, which the firm planned to use to build a chemical plant in the southwestern part of the State. The plant would react sulfuric acid and fluorspar to produce calcium sulfate (gypsum) and hydrogen fluoride. Locating a fluorspar deposit of a sufficient size and grade to sustain the operation was a problem. Such a plant would employ approximately 45 persons.[3]

**Employment.**—Employment in the copper industry continued to decline.

Members of the Carlsbad-area International Brotherhood of Electrical Workers Local 643 voted in March 1984 to freeze wages for contract work for as many as 2 years to give union members a better opportunity to compete for contracts.[4]

**Environment.**—The State Environmental Improvement Board held a public hearing on proposed rules and national standards for three hazardous air pollutants—

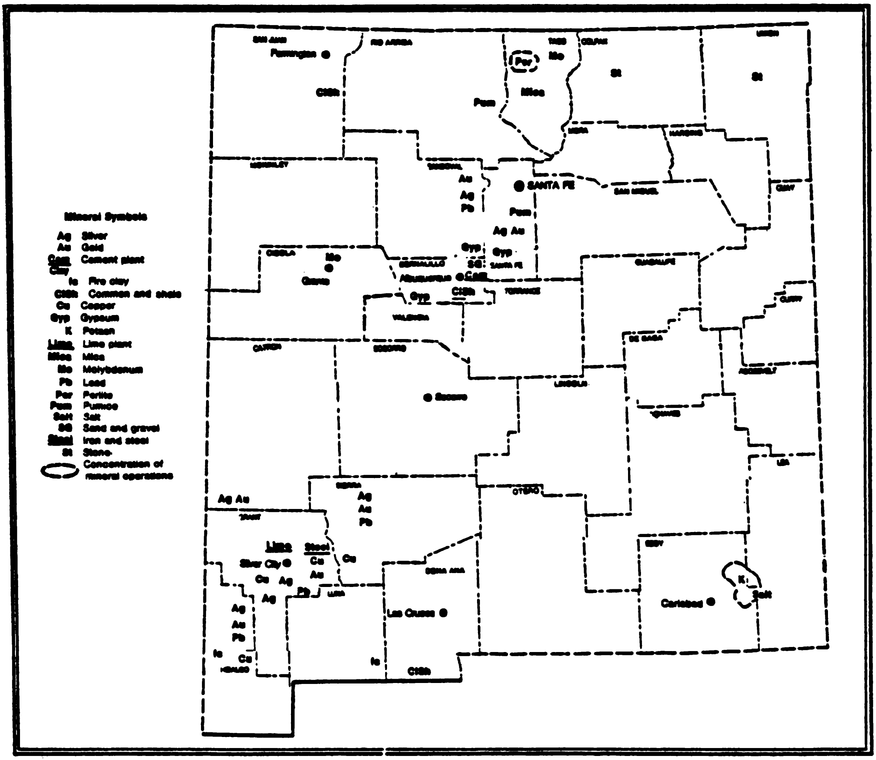

Figure 2.—Principal mineral producing localities in New Mexico.

asbestos, beryllium, and mercury. Regulations proposed would cover new, large air pollution sources and were being written to allow the State to assume enforcement authority from the Federal Environmental Protection Agency (EPA). New Mexico required that new powerplants, sulfuric acid plants, and metal processing plants meet EPA standards, but the State had no enforcement authority.

In early 1984, the EPA issued a rule limiting particulate emissions from new plants started after August 24, 1982. The rule limited the concentration of particulates in stack emissions to 0.05 gram per cubic meter, based on the use of the best demonstrated technology, which, in this case, is high-energy wet scrubbers.[5]

**Exploration Activities.**—Mineral exploration activity in the State in 1984 was even slower than in 1983. Gold and silver were the main targets.

Boliden Minerals Inc. did some offset drilling at its Pinos Altos property near Silver City.

Challenge Mining Co. and Cordex Exploration Co. (a Canadian joint venture group, with headquarters in Reno, NV) explored the Mogollon District in Catron County. Challenge had maintained an aggressive drilling and evaluation program in the area since 1977. Cordex Exploration moved into the Mogollon District in June, concentrating its efforts on properties previously held by St. Joe American Corp.

Dynapac Inc. of Santa Clara, CA, explored its 290 placer claims on and near the Ladder Ranch property in the Las Animas (Hillsboro) mining district. Exxon Minerals Co. was active in Dona Ana County.

Federal Resources Corp. of Salt Lake City, UT, participated in a joint venture with Phelps Dodge Corp. and Westar Resources Inc. at Phelps Dodge's Lordsburg property; a drilling program delineated about 450,000 metric tons of material suitable for smelter flux.[6]

FRM Minerals Inc. completed drilling silver-gold targets in the Winston-Chloride area. The company planned some development work.

Long Lac Exploration Inc., a wholly owned subsidiary of Lac Minerals Ltd. of Canada, continued to evaluate a 34-square-mile area on the Ortiz Mine Grant, including Lukas Canyon, that had been acquired from Conoco Inc. in 1983.

Phelps Dodge's Small Mines Div. evaluated the Virtue Group of claims, about 1-1/2 miles northwest of Tyrone in the Little Burro Mountains, Grant County. The division hoped to locate deposits of precious-metal-bearing flux; initial sampling and exploratory work were said to be encouraging.

Santa Fe Mining Inc., the exploration arm of SF Minerals Corp., in turn a subsidiary of Santa Fe Southern Pacific Corp., continued to explore and develop existing mines in northern and southern New Mexico for precious and base metals and coal. The company surface-drilled a massive sulfide deposit in the old Pecos Mine area of the Sangre de Cristo Mountains.[7]

**Legislation and Government Programs.**—The royalty rate on potash production was revised from 5% to the Federal rate of 2% to 5%, effective January 1, 1984.

New Mexico and seven other Western States filed an Amicus Curiae Brief in December 1984 in the Ninth U.S. Circuit Court, asserting that States were partners with the Federal Government in regulating mining activities on Federal lands and could require a mining company to secure a State permit before operating on Federal land, even though the U.S. Forest Service had approved a plan of operations.[8] The court's decision, however, denied State and county governments the right to permit and regulate mining operations on Federal lands.

The 3,968-acre Bisti Badlands and the 23,872-acre De-na-zin were designated "wilderness" areas by the U.S. Congress on October 30, the first areas to be so named in New Mexico. The areas are in the heart of the coal-rich San Juan Basin, northwestern New Mexico.

In a decision that may have far-reaching implications for mining operations on Indian reservations, the Ninth U.S. Circuit Court of Appeals in San Francisco ruled on April 17 that the Navajo Tribe does not need Federal approval to tax companies holding mining leases on reservation lands.[9]

The first phase of a study of silver and gold deposits in New Mexico was completed and a report published by the New Mexico Bureau of Mines and Mineral Resources.[10]

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

During the year, no placer mines were operated; however, 14 gold-silver-copper lode mines reported output. Six lode mines were in Grant County, two in Hidalgo County, one each in Sandoval and Santa Fe Counties, and four in Sierra County. Grant, Hidalgo, and Sierra Counties produced all three metals. Sandoval County produced silver and copper, and Santa Fe County produced gold. Operations at which metals were recovered only from tailings or precipitates were not counted as producing mines. Lode material was processed to recover gold by cyanidation, by acid leaching (vat, tank, and heap), and by smelting of concentrates.

The State Bureau of Mine Inspection, Division of New Mexico Energy and Minerals Department, listed the following active mills and smelters in 1984: Challenge mill, Challenge of Deming, Catron County; Homestake mill, Homestake Mining Co., Cibola County; Ivanhoe Concentrator mill, Chino Mines Co., Grant County; Tyrone mill, Phelps Dodge, Grant County; St. Cloud mill, St. Cloud Mining Co., Sierra County; and Molycorp. mill, Molycorp Inc., Taos County.[11]

**Copper.**—The U.S. copper industry continued to retrench and to make major efforts to lower operating costs. Average copper prices dropped to their lowest closing price, $0.595 per pound, in almost 2 years on the Commodity Exchange (COMEX) on June 20, 1984, continuing the gradual price decline of the spring of 1984.

Some analysts attributed as much as 15%

of the decline in price for copper to the strength of the dollar against most currencies.

Boliden Mineral AB of Sweden approved $4.8 million for additional underground work at Pinos Altos, north of Silver City.[12] Earlier, underground exploration along a decline went no deeper than 100 meters from the entry; the company planned to explore at a depth of about 150 meters.

Boliden was in its second year of investigations at the Pinos Altos copper-zinc-silver deposit, under a 3-year option from Exxon.[13] When the agreement with Exxon was announced in the spring of 1982, about 7 million tons of ore, grading about 2.5% copper, 3.5% zinc, and 2.5 ounces of silver per ton, already had been delineated.

Boliden completed a one-time sale of about 8,000 metric tons of chalcopyrite ore, containing about 296,000 pounds of copper, to Chino Mines' concentrator at Hurley, late in 1984. The ore had been stockpiled at the minesite north of Silver City, Grant County, and was moved so that a new decline could be extended about 200 feet.

Late in 1984, Boliden contracted with J. S. Redpath Corp., Tucson, AZ, to drive about 4,000 feet of new workings into the lower ore zone at Pinos Altos and to bore an 800-foot ventilation hole. Additional exploratory drilling was to be done from the new decline. In early 1985, Boliden was to file an operations plan with the Gila National Forest to dispose of mill tailings in an arroyo near the underground mine.

Chino Mines, a partnership of Kennecott (a subsidiary of Standard Oil Co. of Ohio (Sohio)) and of Mitsubishi Metal Corp. (a subsidiary of Mitsubishi Corp. of Japan), produced about 96,600 metric tons of copper during 1983 and 88,000 in 1984, according to the 1984 Sohio 10K Annual Report submitted to the Securities and Exchange Commission.

In 1984, Kennecott's modernization program, designed to reduce operating costs and increase capacity at Chino Mines, was completed; a new concentrator had become fully operational in 1983, and the rebuilt smelter became operational in late 1984.

The concentrator at Chino Mines, rated in 1983 at 37,500 tons of copper ore per day, actually achieved about 40,000 tons per day, and plant engineers determined that capacity could be increased to 42,500 tons per day by early 1985. The average grade of ore mined in 1984 was 0.883% copper, slightly higher than that of either 1983 or 1982.

In late April 1984, Chino Mines shipped some of its copper concentrates to a Mitsubishi smelter in Japan. By the end of May, shipments cleared up the large inventory that had developed during the construction of the new, larger concentrator. Kennecott's share of concentrates was shipped to the Garfield smelter in Utah.

At Chino's Hurley smelter, construction was ahead of schedule, and the older reverberatory furnace was shut down for the last time on September 4. The new INCO flash furnace was first charged with concentrate October 15. It nearly doubled Chino's capacity and brought the plant into environmental compliance by capturing more than 90% of $SO_2$ gases.

Phelps Dodge reported its third year of financial losses in 1984, and was forced to sell off or trim marginal operations and implement new technologies. Among these changes were the expansion of its solvent extraction-electrowinning (SX-EW) plant at Tyrone, Grant County, and a major rebuilding of its INCO flash furnace at Playas, Hidalgo County.

Production of electrowon copper began at Tyrone in April 1984, just 13 months after initial groundbreaking and about 5 weeks ahead of schedule. The first shipment of high-purity copper cathodes left the plant April 17, and by May, a daily production rate of 90,000 pounds was attained.[14] The finished product was trucked to the firm's El Paso, TX, refinery.

Although the Tyrone SX-EW plant, operated by Burro Chief Copper Co., cannot recover any gold or silver, it did achieve better copper recovery than traditional leaching-precipitation techniques and was highly labor efficient; only 16 persons were required to operate the plant around the clock. SX-EW copper was produced for as little as 28 cents per pound, about 50% of the cost by conventional mining and smelting. According to the Phelps Dodge 1984 annual report, the firm started an estimated $30 million program to double SX-EW capacity by 1986, by adding 72 electrolytic cells to the earlier group of 84 cells.

The Hidalgo smelter, 10 miles south of Playas, underwent major overhaul and improvements during the year. About 1.64 billion pounds (743,904 metric tons) of copper had been produced in the plant's INCO furnace without any major repair during the 6-year campaign that began in July 1978. In July 1984, the plant was shut down for a scheduled 14-week overhaul to rebuild the flash furnace, replace fire brick, and make general repairs and improvements to other parts of the facility, including the electrostatic precipitators and acid plant. Newly installed concentrate burners were designed to use a higher percentage of coal in the fuel mixture. The $27 million overhaul was expected to generate substantial unit-cost savings.[15]

The inactive Copper Flat porphyry copper deposit in western Sierra County, 4 miles northeast of Hillsboro, continued temporarily under the ownership of Quintana Minerals Corp., of Tucson, and its partner, Phibro Mineral Enterprises Inc., of New York. Geologic studies during the development of this small, low-grade porphyry copper deposit, followed by engineering studies and estimates on capital and operating costs, were described in the literature.[16]

After keeping the Copper Flat operation on standby since the spring of 1982 in the hope of better metal prices, Quintana and Phibro turned the property over to the Canadian Imperial Bank of Commerce in Toronto, Canada, and First City National Bank of Houston, TX.[17]

Sharon Steel Corp. (formerly known as UV Industries/U.S. Smelting & Refining Co.) did not operate its Continental Mine at Fierro, Grant County.

**Gold.**—In 1984, 11 operations (see "Silver" section for names) in New Mexico produced gold. Only Gold Fields Mining Corp.'s Ortiz Mine, of the 11 gold producers, did not also report silver values. Gold output was higher by nearly 6% than in 1983, but total value fell about 10%.

Federal Resources and its two partners, Phelps Dodge and Westar Resources, produced precious-metal-bearing siliceous fluxing ores at a surface mine near Lordsburg, Hidalgo County, but recorded a net loss of $411,000 in the quarter ending January 31, 1985. The net loss compared with a $402,000 net loss for the corresponding period ending January 31, 1984. The partners expected to suspend operations in the spring of 1985, as smelter returns were failing to justify continued operation.[18]

Maintaining careful control of ore grade, Gold Fields mined and processed 914,000 short tons of ore and produced 39,900 troy ounces of gold, valued at $15.6 million, at its Ortiz surface mine, Santa Fe County. In the period 1980-84, 158,000 ounces of gold was produced, according to Gold Fields American Corp.'s 1984 annual report, although mining costs increased and metallurgical recovery fell to about 80% because of increased sulfide mineralization in the ore.[19] Gold Fields operated the mine under a series of temporary permits effective until May 20, 1985, and sought changes to bring the mine into conformity with the Environmental Improvement Division and County Hydrologist requirements.

The Goldfield Corp., a Melbourne, FL, firm reported a $1.8 million operating loss from its St. Cloud-U.S. Treasury Mines in the Black Range, near Chloride, Sierra County. In an effort to curtail losses, as ore grade decreased concurrently with metal prices, monthly production was cut back 50% in August to 5,000 tons. Nevertheless, total tonnage mined at the St. Cloud-U.S. Treasury in 1984 increased 10% over that of 1983 to 95,914 short tons. Tonnage mined during 1984 averaged 0.87% copper, 5.3 ounces silver, and 0.034 ounce gold. Approximately 4% of the year's output was shipped directly to ASARCO Incorporated's El Paso, TX, smelter for use as siliceous flux.[20]

**Iron Ore.**—Sharon Steel continued to ship magnetite concentrates from its stockpile at Silver City. Shipments were significantly higher than in 1983. The magnetite was a byproduct of copper ore produced at the Continental Mine, which was closed in May 1981.

**Molybdenum.**—New Mexico ranked fourth among seven States in the Nation producing molybdenum concentrate. Average value increased to $3.47 per pound, about 6% higher than that of 1983. By yearend 1984, the molybdenum outlook had not improved.[21]

Three companies produced molybdenum disulfide ($MoS_2$) during 1984: Chino Mines; Unocal Corp.'s Molycorp, Questa Div.; and Quivira Mining Co. (a subsidiary of Kerr-McGee), which recovered small amounts of molybdenum as a byproduct of uranium-vanadium mining and milling.

Chino Mines started up its new molybdenum circuit at Hurley in July. Among the new processing techniques investigated during the year to reduce treatment costs was the use of nitrogen in place of oxygen in the flotation circuit. Use of an inert gas such as nitrogen was expected to extend the life of flotation reagents (which oxidize quickly), resulting in substantial cost savings.[22]

In December 1984, Molycorp was producing 12,000 short tons of molybdenum ore per day and employed about 850 people.[23] By 1986-87, the company expected the mine to employ about 900 people and produce about 18,000 tons of ore per day. Exploration at adjacent Goat Hill increased estimated reserves to 131 million tons, grading about 0.294% $MoS_2$. According to Unocal's annual report, improved ore recovery, higher-than-expected ore grade, and effective cost control programs made Questa's operation one of the most efficient in the United States. Questa, once again New Mexico's leading producer—and the third largest molybdenum mine in the world—produced 10,504,000 pounds of molybdenum in concentrates during the year.

The Bureau of Land Management (BLM) office in Taos released in mid-February an environmental analysis on Molycorp's proposed Guadalupe Mountains tailings project, which would be on Federal land. Questa Mine had been using a tailings site on private land 1/2 mile east of Guadalupe Mountain, but the site had capacity for only several more years' use. Environmentalists contemplated legal action to force BLM to prepare a full-scale environmental impact statement for the proposed tailings site on Federal land, but BLM felt the proposal had been adequately addressed in the environmental analysis report.

Molycorp also must meet State Environmental Improvement Division water-discharge standards before construction of the tailings project can begin.

Employees of Questa Mine received stock in the mine's parent company, Unocal, as part of their new contract. Unocal was to purchase for each employee shares worth 0.5% of 1% of the employee's salary in 1984.[24]

Quivira Mining laid off 277 employees from its Ambrosia Lake uranium-vanadium-molybdenum mining and milling operations near Grants, reporting a $5.4 million loss for the first half of 1984, compared with a loss of $1.7 million for the first half of 1983, and reducing the work force to about 430 persons from a 1982 high of 1,000.[25] The layoffs were stated to be necessitated by continuing delays in getting nuclear powerplants operational and by depressed uranium prices.

Quivira Mining produced molybdenum only because, by agreement with the Environmental Improvement Division, it was required to reduce the $MoS_2$ content of the uranium tailings. Tailings from the $U_3O_8$ circuit were split—50% went directly to the tailings dump and 50% was sent through the molybdenum circuit. Quivira Mining processed 531,000 short tons of uranium ore during 1984 and from this amount recovered about 75,000 pounds of $MoS_2$.[26]

**Silver.**—Silver production was 10.5% higher in 1984 than in 1983; total value, however, plunged more than 21%. Eleven mines recorded silver production. In decreasing order of output, the top four were Phelps Dodge's Tyrone Mine, The Goldfield Corp.'s St. Cloud Mine, Resources America Corp.'s Great Republic Mine, and Volcano Mining Co.'s Campbell Mine. The 11 mines were in Grant, Hidalgo, Sandoval, Santa Fe, and Sierra Counties. All but Bland Mining's Washington Claim were also gold producers.

**Tin.**—No tin was reported produced in New Mexico; however, interest in tin mining in the Black Range, Catron County, has been high. The most recent operation, though idle in recent years, was Getman Tin Inc.'s Hiawatha placer and lode mine.

**Tungsten.**—The Bit by Bit Mine reportedly mined and treated tungsten ore in 1984. The ore mineral was scheelite. All the recovered concentrate, containing nearly 52% $WO_3$, was sold to Umetco Minerals Corp., a subsidiary of Union Carbide Corp. No other tungsten output has been recorded from New Mexico in the past decade, and almost none was recorded in earlier times through 1954.[27]

Natural scheelite concentrate, if nodulized, is ideal for direct addition to steel melts. Tungsten carbide and alloys impart hardness, wearability, and other desirable qualities to steel products.[28]

**Vanadium.**—At yearend, Quivira Mining anticipated closing what was once the largest uranium-vanadium mining and milling operation in the Nation, at Ambrosia Lake, McKinley County, in early 1985. Its closure would leave only seven uranium mills in the United States, most operating on a curtailed basis.

Three mining companies, Western Nuclear Inc., Energy Fuels Nuclear Inc., and Uranium Resources Inc. planned to file suit in U.S. District Court against the U.S. Department of Energy, charging that its policies had encouraged foreign uranium imports and caused the collapse of the U.S. uranium industry.[29]

**Zinc.**—Zinc deposits at Hanover in Buckhorn Gulch and at the Groundhog Mine at Vanadium, both in Grant County, were considered for development but no ore was produced.

## NONMETALS

The New Mexico Energy and Minerals Department, Bureau of Mine Inspection, listed 21 active industrial minerals mills in 1984, in Bernalillo, Cibola, Eddy, Luna, Rio Arriba, Sandoval, Santa Fe, Socorro, and Taos Counties. The mills processed clays, gypsum, perlite, potash, pumice, and salt.[30]

**Cement.**—Portland cement output increased about 15% and total value rose 16% over figures for 1983, owing to greater activity in the construction fields. Masonry cement output remained level with that of 1983, but value rose nearly 9%.

Ideal Cement Co., a subsidiary of Ideal Basic, operators of New Mexico's only cement plant, at Tijeras in Bernalillo County, reported a loss from continuing operations of $2.1 million (down substantially from the 1983 loss of $12.7 million), according to the firm's 1984 annual report. Ideal Basic sold its Tijeras plant in December 1983 to General Electric Credit Corp. (GECC) for $53 million and leased back the plant from GECC for 20 years; after 20 years, the lease may be renewed.

A test project on U.S. Highway 180 (New Mexico 62) between Carlsbad and Hobbs in extreme southeastern New Mexico was the first major concrete highway project in the State since 1976, and was the first major test of concrete in highway use in 7 years. The project was developed to study the comparative maintenance requirements of asphalt and portland cement concrete pavements in this particular New Mexico environment.[31]

**Clays.**—Clays sold or used in the State increased 34% in total volume and 24% in total value. Five companies each operated a single pit in 5 of the State's 33 counties; 3 of the pits produced common clay and shale, and 2 produced fire clay.

Common clay and shale output increased 36% over that of 1983; average value was $2.04 per short ton, compared with $1.98 in 1983. Fire clay output was about 19.5% less than in 1983; average value was $6.11 per short ton in 1984, compared with $9.01 in 1983.

In decreasing order by volume, clays were used for face brick, roofing granules, refractory grogs, and quarry tile.

United Desiccant, a division of United Catalysts Inc., of Louisville, KY, and a member of the Süd-Chemie Group of Munich, Federal Republic of Germany, opened a new facility at Belen, Valencia County, to produce desiccant clay products from Arizona bentonites.

**Gem Stones.**—Gem stone production in 1984 was estimated by the U.S. Bureau of Mines to be at the same level as that of 1983. The New Mexico Bureau of Mine Inspection stated, however, that no active turquoise mines have been registered and that no one has commercially mined turquoise in New Mexico since 1982.[32]

The most recent turquoise mining was at Turquoise Hill and Mount Chalchihuitl, north of Cerrillos, Santa Fe County. Older sources were in the Burro Mountains, 6 miles south of Tyrone, and the Eureka District on the eastern side of the Little Hatchet Mountains, near Hachita, both in Grant County, and at Orogrande in the Jarilla Mountains, Otero County.

**Gypsum.**—Crude gypsum production increased a significant 88.2% over that of 1983; however, the average value declined from $6.01 per short ton in 1983 to $5.10 in 1984. In Sandoval County, White Mesa Gypsum Co., a subsidiary of Pomeroy Inc., and Ernest Teeter, at the San Felipe Mine, were producers; in Santa Fe County, Western Gypsum Co. mined gypsum at Rosario. Additionally, Western Gypsum and Allied American Gypsum Co., of Albuquerque, also calcined gypsum; calcined gypsum value rose to an average of $20.39 in 1984. Late in the year, Centex Corp. of Dallas, TX, purchased Allied American Gypsum's wallboard plant at Albuquerque and the White Mesa gypsum mine and crushing plant, 30 miles north of Albuquerque in Sandoval County. The yearend purchases were renamed the Centex American Gypsum Co.

**Mica.**—Mineral Industrial Commodities of America Inc. (M.I.C.A.), Santa Fe, was one of the Nation's five leading producers of scrap (flake) mica; it was also a leading producer of ground mica. Its mill in Rio Arriba County employed 20 workers.[33] M.I.C.A.'s production in Taos County increased by 18.7% over that of 1983.

**Perlite.**—Production of crude perlite ore increased almost 9% to 567,000 short tons in 1984; five mines in the State accounted for 87% of the Nation's total production and 84% of the total processed perlite sold and used. Producers were Grefco Inc., in Socorro and Taos Counties, and Manville Products Corp.,[34] Silbrico Corp., and United States Gypsum Co. in Taos County.

**Potash.**—Five companies produced potash in the State, at least intermittently, from underground, bedded sylvinite and langbeinite deposits east of Carlsbad. The companies were AMAX Chemical, Duval, IMC, Kerr-McGee, and PCA. New Mexico potash producers accounted for 89% of the Nation's total production.

All companies produced at reduced levels but were on normal work schedules for the year until December 3 when AMAX Chemical temporarily closed to reduce inventories. Much of its 433-person work force was laid off until January 29, 1985. The closure was attributed to depressed market conditions, including substantial worldwide inventories that resulted in a significant decrease in the price of potash. High rail-freight rates and relatively poor fertilizer sales, owing to Federal farmland withdrawal programs coupled with a poor agricultural season, were other problems faced by the industry. AMAX Chemical anticipated some recovery in the market as the spring 1985 fertilizing season approached.

Early in 1984, AMAX Chemical and Kerr-McGee brought a lawsuit against the Democratic Republic of Germany, Israel, the Soviet Union, and Spain for illegally dumping potash into U.S. markets at unfair prices. One foreign potash exporter not involved in the dispute was Canada, which supplied 90.3% of the total U.S. imports in 1984.

The U.S. Department of Commerce imposed temporary import duties on potash coming in from Israel and Spain, beginning June 27, 1984. Commerce found both countries to be subsidizing their potash industries, and, to offset those subsidies, an 8.71% duty was placed on Israeli imports and a 7.54% duty on Spanish imports. These import duties, however, were subsequently dropped by order of the U.S. International Trade Commission.

For sale at yearend were the AMAX Chemical sylvinite mine and mill, the Duval langbeinite mine and mill, the Kerr-McGee sylvinite mine and mill, the Mississippi Chemical sylvinite mine and mill, which had been closed since January 1983, and the National Potash Co., which had been closed in February 1982.

Pennzoil Co.'s subsidiary, Duval, put its potash operation near Carlsbad on the sales block in November. The decision followed Pennzoil's decision to take a one-time, aftertax $67 million writedown in the fourth quarter.[35]

IMC, in its 1985 annual report for the fiscal year ending June 30, 1985, stated that its 1985 potash ore reserves in New Mexico amounted to 187 million metric tons, down from 192 million tons at June 30, 1984. The average combined $K_2O$ content for both years was 10%.

IMC developed a commercial process for producing large granular size particles of potassium sulfate at its Carlsbad operation, enabling the firm to provide key fertilizer markets with potassium sulfate products having superior physical and chemical properties.[36]

The Kerr-McGee plant employed about 395 people in 1983 and represented about 18% of the remaining U.S. potash capacity. The facility produced about 3 million tons of ore each year.

PCA reduced operating costs and improved operating efficiency at its aging Carlsbad facility, which, combined with higher ore grades and somewhat higher prices, resulted in the first operating profit at its Carlsbad mine in 3 years.[37] The firm shipped 786,000 tons of potash from its Carlsbad operation in the last half of 1984. The potash-bearing deposits amounted to 18 million tons, but would not be considered ore reserves unless market prices increased or production costs were reduced, according to Ideal Basic's 1984 annual report. Ideal Basic decided in November 1984 to put the property on the market in early 1985.

An updated potash map became available in mid-June from the Roswell District Office of the BLM. The map identified potash ore deposits northeast of Carlsbad and was compiled from the drill log data of 1,918 holes within the 365,488-acre Known Potash Leasing Area. The map was to ensure proper multiple mineral development in the designated potash area and to provide protection for oil, gas, and potash lessees.[38]

### Table 4.—Production and sales of potash in New Mexico

(Thousand metric tons and thousand dollars)

| Period | Crude salts[1] (mine production) | | Marketable potassium salts | | | | |
|---|---|---|---|---|---|---|---|
| | | | Production | | Sold or used | | |
| | Gross weight | $K_2O$ equivalent | Gross weight | $K_2O$ equivalent | Gross weight | $K_2O$ equivalent | Value[2] |
| 1983: | | | | | | | |
| January-June | 6,562 | 851 | 1,251 | 653 | 1,395 | 717 | 96,900 |
| July-December | 5,878 | 748 | 1,129 | 561 | 1,129 | 560 | 77,800 |
| Total[3] | 12,440 | 1,600 | 2,380 | 1,214 | 2,525 | 1,278 | 174,700 |
| 1984: | | | | | | | |
| January-June | 7,209 | 973 | 1,434 | 733 | 1,575 | 801 | 118,000 |
| July-December | 5,884 | 725 | 1,302 | 655 | 1,225 | 618 | 86,100 |
| Total[3] | 13,093 | 1,697 | 2,735 | 1,388 | 2,799 | 1,418 | 204,100 |

[1] Sylvinite and langbeinite.
[2] F.o.b. mine.
[3] Data may not add to totals shown because of independent rounding.

**Pumice.**—New Mexico pumice producers accounted for more than 26% of U.S. production. Four companies processed pumice in Rio Arriba, Sandoval, and Santa Fe Counties. In order of quantity mined, the firms were Copar Pumice Co. Inc. and General Pumice Corp., both at Espanola; Utility Block Co. Inc., at Ponderosa; and American Pumice Co., at Santa Fe. Average value of pumice was $9.62, down from $9.70 in 1983. New Mexico pumice was used in building and decorative blocks, for abrasive uses, and in concrete aggregate.

**Salt.**—Four companies produced evaporated salt in Eddy and Lea Counties. In decreasing order of output, the companies were United Salt Corp., Pioneer Water Co. Inc., New Mexico Salt & Mineral Corp. (formerly called SPN Dismantling Inc.), and Williams Brine Service. Total value and quantities produced increased about 14% and 16%, respectively, in Eddy County, and about 46% and 34%, respectively, in Lea County, over those of 1983. Solar salt was sold for an average of $13.57 per short ton, $0.38 less than in 1983.

**Sand and Gravel (Construction).**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Compared with estimated figures for 1983, New Mexico produced 19% more construction sand and gravel in 1984. Of 33 counties in New Mexico, 27 produced construction sand and gravel. Ninety-six firms and highway departments operated 122 pits and transported 92% of the output by truck; the balance was not transported.

### Table 5.—New Mexico: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 1,915 | $6,344 | $3.31 |
| Plaster and gunite sands | 101 | 248 | 2.45 |
| Concrete products | 1 | 2 | 1.73 |
| Asphaltic concrete | 1,362 | 2,765 | 2.03 |
| Road base and coverings[1] | 2,785 | 7,318 | 2.63 |
| Fill | 425 | 738 | 1.74 |
| Other[2] | 1,775 | 4,974 | 2.80 |
| Total or average | [3]8,363 | 22,389 | 2.68 |

[1] Includes road and other stabilization (cement and lime).
[2] Includes other unspecified uses.
[3] Data do not add to total shown because of independent rounding.

Twenty-eight percent of the operators each produced more than 100,000 short tons of product; Springer Building Materials Corp. was the State's top producer from its Sandia Vista pit in Bernalillo County.

About one-third of the State's output was used for road base and coverings and road stabilization. Construction sand and gravel also was used for concrete aggregates, unspecified uses, asphaltic concrete, fill, plaster and gunite sands, and concrete products. Values ranged from $1.73 per short ton for sand and gravel used in concrete products to $3.31 per short ton for that used in concrete aggregates.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Estimated volume of crushed stone decreased from that of 1983, but estimated value increased about 12%.

*Dimension.*—New Mexico dimension stone output and value increased 5.6% over those of 1983.

**Sulfur (Recovered).**—Elemental sulfur was recovered from natural gas and petroleum refinery operations in Lea, Eddy, San Juan, and Roosevelt Counties. Producers in Lea County, ranked first among the four counties, were El Paso Natural Gas, at Jal and Eunice; Northern Natural Gas Co., at Hobbs; Phillips Petroleum Co., at Buckeye; and Warren Petroleum Co., at Monument. Production in Lea County amounted to 27,173 metric tons. Total production in the State rose about 5% over that of 1983 and 1.6% over that of 1982, but fell short of the 1981 production level by 8.7%.

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[1] State Mineral Officer, Bureau of Mines, Denver, CO.

[2] Mining engineer, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

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## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Ideal Basic Industries Inc., Ideal Cement Co. (Tijeras plant)[1] | Box 8789<br>Denver, CO 80201 | Dry process, 2 rotary-kiln plants. | Bornalillo. |
| Clays: | | | |
| El Paso Brick Co. Inc | Box 12336<br>El Paso, TX 79912 | Open pit mine | Dona Ana. |
| New Mexico Brick Co. Inc., doing business as Kinney Brick Co. Inc. | Box 1804<br>100 Prosperity Ave. SE.<br>Albuquerque, NM 87102 | do | Bernalillo. |
| Copper: | | | |
| Chino Mines Co., a Kennecott-Mitsubishi Metal Corp. partnership.[2] | Hurley, NM 88043 | Open pit mine, flotation mill, precipitation plant, smelter. | Grant. |
| Phelps Dodge Corp., Tyrone Branch[3] | Drawer B<br>Tyrone, NM 88065 | Open pit mine and mill | Do. |
| The Goldfield Corp. (St. Cloud Mining Co.)[4] | 65 East Nasa Blvd.<br>Suite 101<br>Melbourne, FL 32901 | Underground mine, flotation mill. | Sierra. |
| Gypsum: | | | |
| Allied American Gypsum Co | Box 6345, Station B<br>Albuquerque, NM 87197 | Processing and wallboard plant. | Bernalillo. |
| Western Gypsum Co., a subsidiary of Drywall Supply Inc. | Box 2636<br>Sante Fe, NM 87501 | Open pit and wallboard plant. | Sante Fe. |
| White Mesa Gypsum Co. (Pomeroy Inc.) | 10147 North 2d St.<br>Albuquerque, NM 87114 | Open pit | Sandoval. |
| Mica: | | | |
| Mineral Industrial Commodities of America Inc. | Box 2403<br>Santa Fe, NM 87501 | do | Taos. |
| Molybdenum: | | | |
| Molycorp Inc., a division of Unocal Corp. (Questa Div.) | Box 760<br>Los Angeles, CA 90051 | Underground mine and flotation mill. | Do. |
| Quivira Mining Co | Box 218<br>Grants, NM 87020 | Underground mine and mill. | McKinley. |
| Perlite: | | | |
| Grefco Inc., a subsidiary of General Refractories Co. | Box 308<br>Antonito, CO 81120 | Open pit mines; crushing, screening, and air separation. | Socorro and Taos. |
| Manville Sales Corp., a division of Manville Products Corp. | Box 338<br>Antonito, CO 81120 | do | Taos. |
| Silbrico Corp | Box 367<br>Antonito, CO 81120 | Open pit | Do. |
| United States Gypsum Co | Box 216<br>Grants, NM 87020 | Open pit mine and crushing plant. | Cibola. |
| Potash: | | | |
| AMAX Chemical Corp | Box 279<br>Carlsbad, NM 88220 | Underground mine and plant. | Eddy. |
| Duval Corp., a subsidiary of Pennzoil Co.[5] | Box 511<br>Carlsbad, NM 88220 | do | Do. |
| International Minerals & Chemical Corp. | Box 71<br>Carlsbad, NM 88220 | do | Do. |
| Kerr-McGee Chemical Corp., a subsidiary of Kerr-McGee Corp. | Kerr-McGee Bldg.<br>Oklahoma City, OK 73102 | do | Do. |
| Potash Co. of America, a subsidiary of Ideal Basic Industries Inc.[5] | Box 31<br>Carlsbad, NM 88220 | do | Do. |
| Pumice: | | | |
| American Pumice Co., a division of Beatrice Foods Co. (Rhodes Pumice). | Box 4305<br>Santa Fe, NM 87502 | Mill and mine | Santa Fe. |
| Copar Pumice Co. Inc | Box 38<br>Espanola, NM 87532 | Open pit | Do. |
| General Pumice Corp | Box 449<br>Santa Fe, NM 87502 | Open pit mine and crushing and screening plant. | Rio Arriba. |
| Salt: | | | |
| United Salt Corp | Box SS<br>Carlsbad, NM 88220 | Salt lake | Eddy. |
| Pioneer Water Co. Inc | Box 1196<br>Eunice, NM 88321 | do | Lea. |
| Sand and gravel: | | | |
| Albuquerque Gravel Products | Box 829<br>Albuquerque, NM 87103 | Dredge and plant | Bernalillo. |
| Springer Building Materials Corp | Drawer S<br>Albuquerque, NM 87103 | Pit and stationary crushing and screening plant. | Do. |
| Stone: | | | |
| Peter Kiewit Sons Co | Box 521<br>Littleton, CO 80120 | Quarries | Colfax and Union. |

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[1] Also clays and stone.

[2] Also silver and molybdenum.

[3] Also silver, gold, sandstone.

[4] Also silver.

[5] Also salt.

# The Mineral Industry of New York

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New York State Education Department, New York Geological Survey, for collecting information on all nonfuel minerals.**

By Donald K. Harrison[1]

The value of New York's nonfuel mineral production in 1984 was $612.5 million, an increase of $109 million over that of 1983. Leading mineral commodities produced in terms of value were portland cement, crushed stone, salt, construction sand and gravel, zinc, lime, wollastonite, and dimension stone. Nationally, the State ranked 12th in the value of nonfuel minerals produced.

New York was the only State in which emery was mined and accounted for most of the Nation's wollastonite production. The State ranked first in the production of synthetic calcium chloride and synthetic graphite; second in zinc; third in salt, primary aluminum, selenium, and garnet; and fourth in talc and lead.

**Table 1.—Nonfuel mineral production in New York[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays[2] ____ thousand short tons | 371 | $869 | 543 | $2,435 |
| Gem stones | NA | 30 | NA | 30 |
| Lead (recoverable content of ores, etc.) ____ metric tons | 1,299 | 621 | W | W |
| Peat ____ thousand short tons | 18 | W | W | W |
| Salt ____ do | 4,859 | 100,119 | 5,644 | 123,755 |
| Sand and gravel: |  |  |  |  |
| Construction ____ do | [e]18,700 | [e]54,200 | 25,968 | 80,866 |
| Industrial ____ do | W | W | 25 | 260 |
| Silver (recoverable content of ores, etc.) ____ thousand troy ounces | 33 | 379 | W | W |
| Stone: |  |  |  |  |
| Crushed ____ thousand short tons | [r]31,991 | [r]134,752 | [e]33,100 | [e]135,000 |
| Dimension ____ do | 24 | 4,310 | [e]15 | [e]4,271 |
| Zinc (recoverable content of ores, etc.) ____ metric tons | 56,748 | 51,783 | W | W |
| Combined value of cement, clays (ball clay), emery, garnet (abrasive), gypsum, lime, talc, titanium concentrate (ilmenite), wollastonite, and values indicated by symbol W | XX | 156,351 | XX | 265,873 |
| Total | XX | [r]503,414 | XX | 612,490 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes ball clay; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in New York, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Albany | W | W | Cement, stone (crushed), clays, stone (dimension). |
| Allegany | $1,338 | (2) | |
| Broome | W | W | Clays, peat. |
| Cattaraugus | 6,582 | W | Peat. |
| Cayuga | 401 | (2) | |
| Chautauqua | 572 | (2) | |
| Chemung | 552 | (2) | |
| Chenango | 643 | (2) | |
| Clinton | 338 | W | Stone (crushed). |
| Columbia | 647 | W | Do. |
| Cortland | 1,009 | (2) | |
| Delaware | 39 | W | Stone (dimension), stone (crushed). |
| Dutchess | W | W | Stone (crushed), peat. |
| Erie | W | W | Stone (crushed), clays. |
| Essex | 13,234 | W | Wollastonite, stone (dimension), titanium, abrasives. |
| Franklin | 148 | $172 | Stone (crushed), stone (dimension). |
| Fulton | 378 | (2) | |
| Genesee | W | W | Gypsum, stone (crushed). |
| Greene | W | W | Cement, stone (crushed). |
| Herkimer | 852 | W | Stone (crushed). |
| Jefferson | 705 | W | Do. |
| Lewis | W | W | Wollastonite, stone (crushed). |
| Livingston | W | W | Salt, stone (crushed). |
| Madison | 99 | 1,458 | Stone (crushed). |
| Monroe | 1,121 | W | Do. |
| Montgomery | W | 3,566 | Do. |
| Nassau | W | (2) | |
| Niagara | (3) | W | Stone (crushed). |
| Oneida | 940 | W | Stone (crushed), sand (industrial). |
| Onondaga | 34,184 | W | Lime, stone (crushed), salt, clays. |
| Ontario | 674 | W | Stone (crushed). |
| Orange | W | W | Stone (crushed), clays. |
| Orleans | W | W | Stone (crushed), stone (dimension). |
| Oswego | 830 | (2) | |
| Otsego | 284 | (2) | |
| Putnam | (3) | W | Stone (crushed). |
| Rensselaer | 2,212 | W | Do. |
| Rockland | (3) | 17,709 | Do. |
| St. Lawrence | W | W | Zinc, talc, stone (crushed), lead, silver. |
| Saratoga | 245 | W | Stone (crushed), sand (industrial). |
| Schenectady | W | (2) | |
| Schoharie | W | W | Cement, stone (crushed). |
| Schuyler | W | W | Salt. |
| Seneca | W | W | Stone (crushed), peat. |
| Steuben | 1,432 | W | Stone (crushed). |
| Suffolk | 3,998 | (2) | |
| Sullivan | 362 | W | Stone (crushed). |
| Tioga | 952 | (2) | |
| Tompkins | W | W | Salt, stone (crushed), stone (dimension). |
| Ulster | W | W | Stone (crushed), clays. |
| Warren | W | W | Cement, stone (crushed), abrasives. |
| Washington | 158 | W | Stone (crushed), stone (dimension). |
| Wayne | 737 | W | Stone (crushed). |
| Westchester | W | W | Abrasives, peat, stone (dimension). |
| Wyoming | W | W | Salt. |
| Yates | 89 | (2) | |
| Undistributed[4] | 291,351 | 426,308 | |
| Sand and gravel (construction) | XX | [e]54,200 | |
| Stone: | | | |
| Crushed | [e]132,800 | XX | |
| Dimension | [r] [e]3,952 | XX | |
| Total | [r]503,858 | [5]503,414 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No production of nonfuel mineral commodities was reported for counties not listed.

[2]Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3]Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[4]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of New York business activity

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| **Employment and labor force, annual average:** | | | |
| Population thousands | 17,567 | 17,663 | 17,735 |
| Total civilian labor force do. | 7,991 | 8,051 | 8,089 |
| Unemployment do. | 684 | 688 | 584 |
| Employment (nonagricultural): | | | |
| Mining total[1] do. | 6.5 | 6.7 | 6.8 |
| Metal mining[2] do. | 1.3 | 1.2 | NA |
| Nonmetallic minerals except fuels[2] do. | 3.6 | 3.6 | NA |
| Coal mining[2] do. | (3) | (3) | NA |
| Oil and gas extraction[2] do. | 2.5 | 2.7 | NA |
| Manufacturing total do. | 1,352.5 | 1,302.4 | 1,330.2 |
| Primary metal industries do. | 40.6 | 35.4 | 34.1 |
| Stone, clay, and glass products do. | 33.0 | 31.8 | 32.2 |
| Chemicals and allied products do. | 66.8 | 64.7 | 65.6 |
| Petroleum and coal products do. | 6.0 | 6.2 | 5.6 |
| Construction do. | 219.6 | 230.8 | 251.8 |
| Transportation and public utilities do. | 422.0 | 406.7 | 417.6 |
| Wholesale and retail trade do. | 1,468.4 | 1,503.4 | 1,567.9 |
| Finance, insurance, real estate do. | 670.6 | 686.7 | 703.5 |
| Services do. | 1,821.3 | 1,876.9 | 1,962.0 |
| Government and government enterprises do. | 1,293.7 | 1,299.6 | 1,317.3 |
| Total[4] do. | 7,254.6 | 7,313.3 | 7,557.0 |
| **Personal income:** | | | |
| Total millions | $214,974 | $231,054 | $253,934 |
| Per capita | $12,237 | $13,081 | $14,318 |
| **Hours and earnings:** | | | |
| Total average weekly hours, production workers | 38.8 | 39.3 | NA |
| Total average hourly earnings, production workers | $8.35 | $8.85 | NA |
| **Earnings by industry:** | | | |
| Farm income millions | $537 | $476 | $528 |
| Nonfarm do. | $156,652 | $169,781 | $186,351 |
| Mining total do. | $288 | $289 | $289 |
| Metal mining do. | $38 | $45 | $37 |
| Nonmetallic minerals except fuels do. | $89 | $91 | $105 |
| Coal mining do. | $1 | $1 | $1 |
| Oil and gas extraction do. | $161 | $151 | $146 |
| Manufacturing total do. | $33,805 | $34,846 | $37,453 |
| Primary metal industries do. | $1,238 | $1,142 | $1,130 |
| Stone, clay, and glass products do. | $842 | $896 | $942 |
| Chemicals and allied products do. | $2,011 | $2,055 | $2,228 |
| Petroleum and coal products do. | $965 | $1,051 | $982 |
| Construction do. | $5,726 | $6,547 | $7,604 |
| Transportation and public utilities do. | $13,689 | $13,636 | $14,727 |
| Wholesale and retail trade do. | $24,144 | $25,978 | $28,639 |
| Finance, insurance, real estate do. | $17,743 | $20,677 | $22,877 |
| Services do. | $36,527 | $41,001 | $45,688 |
| Government and government enterprises do. | $24,292 | $26,325 | $28,541 |
| **Construction activity:** | | | |
| Number of private and public residential units authorized | 25,369 | 37,958 | 43,160 |
| Value of nonresidential construction millions | $2,151.5 | $1,644.3 | $2,105.2 |
| Value of State road contract awards do. | $561.0 | $570.0 | $979.9 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 2,362 | 2,533 | 2,785 |
| **Nonfuel mineral production value:** | | | |
| Total crude mineral value millions | $503.9 | $503.4 | $612.5 |
| Value per capita | $29 | $29 | $35 |

[p]Preliminary. [r]Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Less than 50 employees.

[4] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

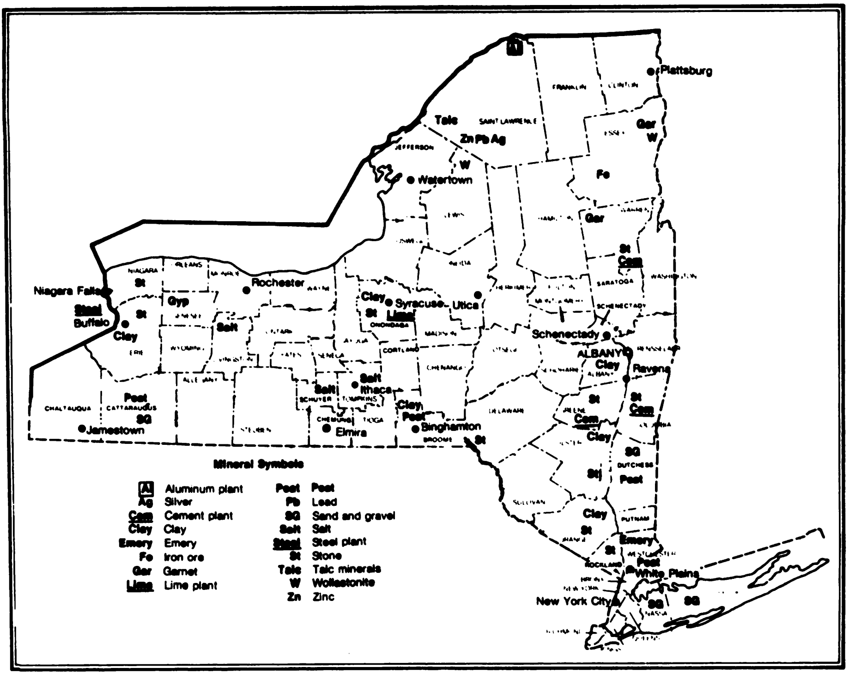

Figure 1.—Principal mineral producing localities in New York.

**Trends and Developments.**—Environmental issues continued to be major topics of concern in the State. One key issue has been the acid rain controversy and its effects on water quality and vegetation, primarily in the Adirondack Mountains. In an effort to combat the problem, the State passed the New York State Acid Deposition Control Act and has conducted or authorized numerous studies on the controversial subject. In addition, Maine, New York, and Pennsylvania filed petitions with the Environmental Protection Agency (EPA) to impose stricter sulfur dioxide levels on seven Midwestern States. The petitions, filed in 1980 and 1981, stated that emissions from Midwestern power and industrial plants were preventing the Northeastern States from meeting air quality standards. EPA denied the petitions, however, noting that the States that filed the petitions "have not made a persuasive technical case that the existing requirements of the Clean Air Act were being violated by interstate transport of air pollutants."

In an environmentally related issue regarding mineral resources, the State Department of Health began a widespread investigation to determine whether workers in the talc mines of St. Lawrence County were being disabled from exposure to toxic elements in the mines, including asbestos. However, controversy continued during the year as to whether or not to exclude talc from the definition of asbestos. There were conflicting opinions by both the Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health as to how to classify the talc, which is composed basically of the mineral tremolite.

**Legislation and Government Programs.**—Near yearend, the New York State Acid Deposition Control Act was signed into law. The legislation required large decreases in sulfur dioxide and nitrogen oxide emissions and applied to all major steam electric plants and industrial plants in the State. It mandated the reduction of New York State's emissions by 12% or 100,000 tons by 1988 and by an additional 18% by the early 1990's. It was contingent upon no similar Federal plan being enacted.

In August, a new bonding requirement law was passed. It enacted new provisions fixing bonding or other financial security requirements for wells less than 6,000 feet in depth for which the New York Environmental Conservation Department has issued permits on or after June 5, 1973. The bondng requirement law affected (1) oil pools or fields, (2) natural gas pools or fields, and (3) solution mining areas.

Near yearend, the Governor was planning to add a new dimension to the bottle law, which became effective in October 1983. The proposed legislation would enable the State to collect unrefunded 5-cent deposits from beverage distributors. According to State officials, New York State consumers failed to claim $54 million in deposits during the first 10 months after the bottle law was in force.

On a local level, the town of Olean passed an ordinance regulating strip mining and oil well drilling within the city limits, and at yearend, the town of Ulster completed revisions of the local mining ordinance. The revisions were expected to be voted on as the town's first local law of 1985 after a public hearing in January.

The New York State Geological Survey, which has operated continuously since 1836, has two basic functions: (1) to act as the geological research arm of the State Museum, and (2) to act as keeper of the State geologic map for provision of geological advice to the government, industry, and the public. In 1984, major projects continuing or under way were concerned with environmental and engineering or regional geologic studies. Projects under way in the environmental and engineering studies included (1) production of county bedrock maps for engineering purposes; (2) study of landslides in the Hudson River Valley, funded by the U.S. Geological Survey (USGS); (3) statewide evaluation of potential siting of low-level radioactive waste disposal; (4) statewide appraisal of data relevant to the siting of a high-level radioactive waste disposal in crystalline rock, funded by the U.S. Department of Energy; (5) geochemistry of glacial soils; and (6) study of Outer Continental Shelf petroleum development, funded by the Minerals Management Service.

Regional geologic studies included (1) subsurface stratigraphy of the Devonian Age rocks of central and western New York; (2) quadrangle mapping of the Adirondack Mountains at 1:24,000 and 1:62,000; (3) Cambro-Ordovician Age biostratigraphy, funded by the National Science Foundation; (4) regional structures of the Adirondack Mountains; (5) quaternary geologic mapping of New York at 1:250,000; and (6) cataloging of mineral resource localities in the Adirondacks, funded by the USGS.

During fiscal year 1984, the U.S. Bureau of Mines had 13 active contracts or grants in New York valued at $374,415. The contracts were awarded to educational institutions and industrial and consulting firms for mineral-related studies.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Abrasives (Manufactured).**—High-purity fused aluminum oxide was produced by Sohio Electro Minerals Co. and by the General Abrasives Div. of Dresser Industries Inc., both in Niagara Falls. General Abrasives also produced a small amount of high-purity fused aluminum oxide from abrasive-grade bauxite. Sohio Electro Minerals (formerly the Electrominerals Div. of The Carborundum Co.) was formed in 1983 when Carborundum consolidated with the Processed Mineral Sector of Sohio Chemical & Industrial Products Co.

Pellets Inc. produced cut wire shot for abrasive purposes at a plant in Tonawanda, Erie County.

**Calcium Chloride (Synthetic).**—New York ranked first among three States that produced synthetic calcium chloride. Allied Chemical Corp. recovered synthetic calcium chloride as a byproduct of soda ash production at its Solvay plant near Syracuse. The calcium chloride was used for ice and snow removal and as a dust suppressant.

**Cement.**—In 1984, cement was the leading nonfuel mineral produced in terms of value. Four companies operated five plants in the State. All five produced portland cement and three produced masonry cement. The four plants producing both portland and masonry were Lehigh Portland Cement Co. at Cementon, Atlantic Cement Co. Inc. at Ravena, Moore McCormack Resources Inc. at Glens Falls, and Independent Cement Corp. at Catskill. Moore McCormack also operated a second plant at Howes Cave but produced only portland cement there. In 1984, both shipments and value of portland cement increased 11% and 40%, respectively, compared with those of 1983. Shipments and value of masonry cement increased by 9% and 10%, respectively.

During the year, Lone Star Industries Inc. sold its Catskill cement plant and distribution network to St. Lawrence Cement Inc. for $30 million. St. Lawrence Cement is a Canadian concern based in Mount Royal, Quebec, with a subsidiary, Independent Cement, in Albany. Because Independent distributed cement produced in Canada, it was barred from supplying Federal and State highway projects because they are covered by the "Buy America" restrictions of the Federal Surface Transportation Assistance Act of 1982. However, with the acquisition of the Catskill plant, Independent Cement was expected to bid again on State and Federal highway projects.

In May, a nationwide strike by workers against Lehigh, closed the Cementon plant to all but limited shipping. In June, however, the 130 Cementon plant employees went back to work pending negotiations with the company through a Federal mediator.

**Clays.**—In 1984, both common and ball clay were produced in the State. Common clay was produced by eight companies in six counties. Leading counties in order of output were Albany, Ulster, Onondaga, Broome, Orange, and Erie. A small amount of slip clay (statistically tallied as ball clay) was produced by one company, Industrial Mineral Products Inc. in Albany County. Both quantity and value of common clay increased substantially in 1984; output was 46% more than that of 1983, while value increased nearly threefold.

**Emery.**—New York continued to be the only State that produced emery. Two companies, De Luca Emery Mine Inc. and John Leardi Emery Mine, both operated mines near Peekskill in Westchester County. Production and value rebounded in 1984, increasing 48% and 53%, respectively, over those of 1983.

**Garnet.**—In 1984, two of the Nation's four garnet mines operated in the State. New York ranked third in production but second in value after Idaho. Barton Mines Corp. operated an open pit mine in Warren County and sold the garnet for use in coated abrasives, glass grinding and polishing, and metal lapping. The NYCO Div. of Processed Minerals Inc. operated a mine in Essex County and sold the material for use in sandblasting and in bonded abrasives. The recovered garnet at the NYCO operation was a byproduct of wollastonite mining.

**Gem Stones.**—Value of gem stones and mineral specimens collected by mineral dealers and amateur collectors in New York was estimated at $30,000 in 1984. Popular gem collecting localities included Gore Mountain near North Creek, Warren County; magnetite refuse areas of NL Industries Inc. near Tahawus, Essex County; and Herkimer County, where double-terminated clear quartz crystals are found in a dolomite matrix.

**Graphite (Synthetic).**—New York led the Nation in the production of synthetic graphite, accounting for about one-fourth of the U.S. output. Production amounted to 65,013 short tons, an 11% decrease compared with that of 1983. Four companies, all located in Niagara County, produced synthetic graphite. The four companies were Airco Carbon, a division of Airco Inc.; Carborundum's Graphite Products Div.; Great Lakes Carbon Corp.; and Union Carbide Corp., Carbon Products Div. Principal uses of the synthetic graphite were for electrodes, cathodes, anodes, crucibles and vessels, lubricants, and unmachined graphite shapes.

**Gypsum.**—United States Gypsum Co., the State's only producer, mined gypsum from its underground mine at Oakfield in Genesee County. In 1984, both output and value of crude gypsum increased appreciably compared with those of 1983. The crude gypsum mined at the Oakfield Mine and gypsum imported from Canada was calcined at two company-owned plants in Oakfield and at Stony Point, Rockland County. In terms of total output, the Stony Point plant ranked seventh of 71 plants that calcined gypsum in the United States.

Two other companies calcined imported gypsum in the State. National Gypsum Co. operated a plant in Rensselaer County, and Georgia-Pacific Corp. operated a plant in Buchanan, Westchester County. Calcined gypsum was primarily used for wallboard and plaster. State output and value of calcined gypsum increased somewhat compared with those of 1983.

The site of National Gypsum's former wallboard plant in Clarence, closed since 1982, was in the process of becoming the city's newest industrial park. The plant had been in operation for 50 years.

**Iodine.**—Crude iodine was shipped into the State by RSA Corp., Westchester County, and Sterling Organics U.S., Rensselaer County. RSA, the largest producer in New York, produced specialty organic chemicals. Sterling used the iodine for the manufacture of pharmaceuticals, catalysts, and sanitation products.

**Lime.**—One company, Allied Chemical, produced quicklime in 1984 at its Syracuse

Works plant in Onondaga County. In terms of total output, the plant was the Nation's sixth leading lime plant, down from third place in 1983. The quicklime was used for manufacturing synthetic soda ash. Both output and value remained essentially the same as those of 1983.

**Mullite (Synthetic).**—Carborundum, Niagara Falls, was the only producer of electric-furnace-fused mullite in New York. The mullite was primarily used by the steel industry for furnace linings.

**Peat.**—New York ranked eighth of 22 States that produced peat in 1984. Four companies (two less than in 1983) mined peat from four operations in Broome, Cattaraugus, Dutchess, and Westchester Counties. Both reed sedge and humus were produced primarily for soil improvement and potting soil. A demonstration project to mine and burn peat at the Fort Drum Military Reservation continued to be evaluated. The project, sponsored by the New York State Energy Research Development Authority, was an effort to evaluate the State's renewable energy resources. To date, test borings, water sampling, and survey work have been undertaken at the project site.

**Perlite (Expanded).**—Crude perlite mined in other States was expanded by Buffalo Perlite Corp., a division of Pine Hill Concrete Mix Corp., Erie County, and by Solite International Corp., Rensselaer County. Both output and value rebounded in 1984, increasing 26% and 35%, respectively. The expanded perlite was primarily used in lightweight acoustical building plaster, loose-fill insulation, soil conditioning, and for filtration.

**Salt.**—New York ranked third in the Nation in salt output, after Louisiana and Texas. Production totaled 5.6 million short tons valued at nearly $124 million, reflecting an increase of 16% in quantity and 24% in value. Both rock salt and brine were produced by four companies at five operations in five counties. Rock salt, used primarily for snow and ice removal, was produced by Cargill Inc. in Tomkins County and by International Salt Co. in Livingston County. Brine was produced at one operation—Allied Chemical, Onondaga County. Evaporated salt was produced by Cargill and International Salt, each operating a plant in Schuyler County, and by Morton Thiokol Inc., at a plant in Wyoming County. The brine was primarily used in the manufacture of soda ash, chlorine, and other chemicals.

In March, International Salt's Retsof salt mine, Livingston County, became the first deep salt mine in North America to produce 100 million tons of rock salt. The mine has been in continuous operation since 1885. Most of the rock salt mined at Retsof is shipped in bulk by rail for use in highway ice removal and as an essential raw material for the chloralkali chemical industry.

In October, Du Pont Chemical Corp., a subsidiary of E. I. duPont de Nemours & Co. Inc., and Olin Chemical Co., a subsidiary of Olin Corp., began test drilling at four sites near the village of Wyoming to evaluate the salt brine potential of the area. The test wells will be approximately 30 feet deep and 500 feet apart.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of construction sand and gravel increased nearly 39% in 1984 compared with the 1983 level, reflecting increased contract construction in residential, nonresidential, highway, and public projects.

In 1984, 379 companies and government agencies mined construction sand and gravel from 478 operations in 53 counties. Leading counties in order of output were Suffolk, Nassau, Cattaraugus, and Dutchess. Main uses for the material were for road base and coverings, concrete aggregate, and fill.

**Table 4.—New York: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,849 | $15,041 | $3.91 |
| Plaster and gunite sands | 150 | 586 | 3.91 |
| Concrete products | 468 | 1,362 | 2.91 |
| Asphaltic concrete | 1,692 | 6,372 | 3.77 |
| Road base and coverings[1] | 3,921 | 10,195 | 2.60 |
| Fill | 2,088 | 4,220 | 2.02 |
| Snow and ice control | 1,321 | 3,217 | 2.43 |
| Railroad ballast | (2) | (2) | 2.00 |
| Other[3] | 12,479 | 39,872 | 3.20 |
| Total or average | 25,968 | [4]80,866 | 3.11 |

[1] Includes road and other stabilization (cement).
[2] Less than 1/2 unit.
[3] Includes roofing granules and other unspecified uses.
[4] Data do not add to total shown because of independent rounding.

*Industrial.*—Whitehead Bros. Co. was the only industrial sand producer in New York in 1984. The company operated one pit in Saratoga County. Major sales were for glassmaking, moldings, and foundry purposes.

**Slag—Iron.**—Buffalo Crushed Stone Corp. was the only company that processed air-cooled iron (blast furnace) slag in 1984. Main uses for the slag were for road base, asphaltic concrete aggregates, fill, and railroad ballast.

**Sodium Carbonate (Synthetic).**—New York was the only State that produced synthetic sodium carbonate in 1984. Allied Chemical mined a chemical-grade limestone at its Jamesville quarry south of Syracuse and shipped the limestone to its Solvay-process plant in Solvay situated west of Syracuse. Synthetic sodium carbonate was used primarily in glass, chemical, detergent, and paper manufacture; for leather tanning; and for water treatment. At yearend, Allied Chemical sold its sodium bicarbonate facility at its synthetic soda ash plant to Church & Dwight Co.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Estimated crushed stone production totaled 33.1 million short tons valued at $135 million, nearly the same as that of 1983. Limestone was the leading type of crushed stone produced. Other types included traprock, sandstone, granite, and dolomite. Main uses for the crushed stone were for road base, bituminous aggregate, cement manufacture, and fill.

*Dimension.*—The survey of dimension stone producers was not conducted in 1984 since data is collected only for odd-numbered years. The preliminary survey for 1984, which collected production information on a sample basis for the first 9 months only, was used to generate the State's preliminary estimates. Based on these estimates, dimension stone production in 1984 amounted to 14,859 short tons (184,200 cubic feet). Types of stone quarried were sandstone, granite, and slate.

**Talc.**—New York ranked fourth of 11 States that produced talc in 1984. The Gouverneur Talc Co. Inc., a subsidiary of R. T. Vanderbilt Co. Inc., was the only producer in the State. The company mined a steeply dipping massive white tremolite-talc ore body approximately 300 feet wide. The ore was used primarily for ceramics and paint additives.

During the year, the New York State Department of Health launched a $150,000 investigation to determine whether workers in the talc mines of St. Lawrence County were being disabled from exposure of toxic elements in the mines. The study will try to determine whether there is a link between a high incidence of lung disease in the area and talc mining.

**Vermiculite (Exfoliated).**—W. R. Grace & Co. exfoliated crude vermiculite shipped in from out of State at its plant in Weedsport, Cayuga County. In 1983, both output and value decreased 9% and 8%, respectively, compared with those of 1983. The exfoliated vermiculite was primarily used for loose-fill insulation, block insulation, horticulture, lightweight concrete aggregate, and soil conditioning.

**Wollastonite.**—New York led the Nation in the production of wollastonite, accounting for virtually all of the Nation's output. A small amount was also produced in California. Two companies mined wollastonite in the State in 1984. NYCO, a division of Processed Minerals and leading world supplier of this unique mineral, operated both an underground mine and surface operation in Essex County. NYCO's surface operation (Lewis Mine), which began development in 1982, was expected to replace the underground Willsboro Mine, which was near depletion. At the Lewis operation, the company installed a 300-short-ton-per-hour portable crushing system. The crushed ore was trucked 14 miles to the mill at Willsboro. The State's other producer, R. T. Vanderbilt, operated the Valentine underground mine in Lewis County. Major uses of wollastonite are as a filler in ceramic tile, marine wallboard, paint, plastics, and refractory liners in steel mills.

## METALS

**Aluminum.**—In 1984, New York ranked third in output and value among the 17 States that had primary aluminum production facilities. Although output was nearly the same, value increased nearly 5%. Primary aluminum was produced by two companies, both in Massena, St. Lawrence County. Aluminum Co. of America (Alcoa) operated a 226,000-short-ton-per-year smelter, and Reynolds Metals Co. operated a 126,000-ton-per-year smelter. Both smelters operated at full capacity throughout the year.

During the year, Alcoa earmarked between $20 million and $25 million annually over the next 5 years for capital expenditures in facility modernization, principally in automation and new technology. A new continuous caster and rod rolling mill under construction was expected to come onstream in January 1985. The new caster would produce nonconductor redraw rod for the cable mill of Alcoa Conductor Products Co., also in Massena.

**Ferroalloys.**—New York was 1 of 17 States that produced ferroalloys in 1984. The State's three producers, all in Niagara Falls, were Elkem Metals Co., SKW Alloys Inc., and Union Carbide, Metals Div.

**Iron Ore.**—Stockpiled byproduct magnetite from NL Industries' MacIntyre Mine continued to be shipped by rail mainly for use in coal preparation plants. Estimates of the stockpiled magnetite from the mine, closed since 1982, were 5 to 6 million short tons of ore.

**Iron and Steel.**—In 1984, both pig iron shipments and raw steel production decreased substantially, the result of Bethlehem Steel Corp.'s closure of the massive Lackawanna plant near Buffalo. The plant at one time produced 13 million short tons of raw steel annually and employed nearly 21,000 workers. Raw steel production decreased from 1.3 million tons in 1983 to 0.5 million tons in 1984.

At yearend, Republic Steel Corp. wrote off its idled Buffalo plant. The integrated plant, which produced bar products and semifinished steel, was idled in 1982. The mill had one blast furnace and a basic oxygen process furnace shop. A coke facility there, 50% owned by Republic, has also been idle since 1982.

In March, Al Tech Specialty Steel Corp. started operating a new two-strand billet caster at its Watervliet melt shop. The caster, which cost $7.5 million, was expected to increase production and cut costs of producing billets for the company's 14-inch rolling and rod mills at Dunkirk. In addition, Al Tech announced that it would start a $6.5 million capital improvements program at its Watervliet and Dunkirk plants. Plans called for a new tube reducer, revamping of its 21-inch mill, installation of new electric controls at its bar and rod mill, and installation of new finishing equipment.

Early in the year, Allegheny Ludlum Steel Corp. acquired the assets of the shuttered Guterl Special Steel Corp. for $9.5 million at a court-ordered auction, putting the specialty steelmaker into the vacuum melted superalloy and high-temperature metals business. No timetable for the startup of the facility was established, but Allegheny Ludlum estimated that 60 to 90 days would be required to commission the equipment and staff the plant. Guterl Special Steel, which once employed 1,200 workers at its plant, and its parent, Guterl Steel Corp., filed for reorganization bankruptcy in August 1982. The sale had to be approved by the U.S. Department of Defense because some of the specialty steel products made at the plant were used by the nuclear industry.

In February, Cyprus Corp. approved an $8 million program for the modernization of facilities at the company-owned Special Metals Corp., a New Hartford, NY-based, producer of superalloys. The melting, finishing, and inspection facilities and research and development activities were scheduled to be included in the modernization project. The company made superalloys and other specialty metals for aerospace and other industries.

**Lead and Silver.**—Lead was recovered as a byproduct of zinc mining operations of the St. Joe Resources Co., a unit of Fluor Corp., at Balmat. Both output and value increased in 1984. Silver, also recovered during the lead processing, increased in output.

**Table 5.—New York: Mine production (recoverable) of silver, lead, and zinc**

| | | 1983 | 1984 |
|---|---|---|---|
| Mines producing: Lode | | 3 | 2 |
| Material sold or treated: Zinc ore | thousand short tons | 683 | W |
| Production: | | | |
| Quantity: | | | |
| Silver | troy ounces | 33,137 | W |
| Lead | metric tons | 1,299 | W |
| Zinc | do | 56,748 | W |
| Value: | | | |
| Silver | thousands | $379 | W |
| Lead | do | $621 | W |
| Zinc | do | $51,783 | W |
| Total | do | $52,783 | W |

W Withheld to avoid disclosing company proprietary data.

**Titanium Concentrate.**—NL Industries ceased ilmenite production at its Tahawus facility in Essex County, the result of the 1982 closure of its titanium dioxide pigment plant in Sayreville, NJ. However, some stockpiled material was shipped during 1984.

**Zinc.**—In 1984, New York ranked second in zinc output, up from third place in 1983. Tennessee continued as the leading producer in the Nation. St. Joe Resources, the sole producer in the State, operated two mines (Balmat and Pierrepont) in St. Lawrence County. In 1984, the Balmat Mine became the Nation's leading zinc mine in terms of total output; the Pierrepont Mine ranked seventh. All ore was milled at the company's Balmat mill, which had an ore milling capacity of 4,300 short tons per day. Zinc recovery was about 94% with a concentrate grade of about 58% zinc. The concentrates were mainly processed at the company's zinc smelter at Monaca, PA. Concentrates in excess of smelter requirements were sold to other zinc producers or refined to metal for St. Joe Resources under tolling agreements with other companies. The company's zinc metal is used primarily in galvanizing and in brass and bronze fabrication.[2]

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] Fluor Corp. Security and Exchange Commission 1984 Form 10-K. Pp. 10-11.

## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Abrasives (manufactured): | | | |
| General Abrasives Div. of Dresser Industries Inc. | 2000 College Ave.<br>Niagara Falls, NY 14305 | Plant | Niagara. |
| Pellets Inc | 531 South Niagara St.<br>Tonawanda, NY 14150 | do | Erie. |
| Sohio Electro Minerals Co.[1] | Box 423<br>Niagara Falls, NY 14302 | do | Niagara. |
| Aluminum (primary): | | | |
| Aluminum Co. of America | 1210 Alcoa Bldg.<br>Pittsburgh, PA 15222 | Smelter | St. Lawrence. |
| Reynolds Metals Co | Box 27003-2A<br>Richmond, VA 23215 | do | Do. |
| Cement: | | | |
| Atlantic Cement Co. Inc., a subsidiary of Newmont Mining Corp.[2] | Box 30<br>Stamford, CT 06904 | Quarry and plant. | Albany. |
| The Glens Falls Portland Cement Co. Inc., a subsidiary of Moore McCormack Resources Inc.[2] | Box 440<br>Glens Falls, NY 12801 | Quarries and plants. | Schoharie and Warren. |
| Lehigh Portland Cement Co.[2] | 718 Hamilton Mall<br>Allentown, PA 18105 | Quarry and plant. | Greene. |
| St. Lawrence Cement Inc | Mount Royal<br>Quebec, Canada | do | Do. |
| Clays: | | | |
| Norlite Corp., a subsidiary of P. J. Keating Co. | Box 367<br>Fitchburg, MD 01420 | Pit | Albany. |
| Northeast Solite Corp., a subsidiary of Solite Corp. | Box 27211<br>Richmond, VA 23261 | Pit | Ulster. |
| Powell & Minnock Inc., a subsidiary of General Dynamics Corp. | Coeymans, NY 12045 | Pits | Do. |
| Emery: | | | |
| De Luca Emery Mine Inc | 929 Constant Ave.<br>Peekskill, NY 10566 | Pit | Westchester. |
| John Leardi Emery Mine | Gillman Lane<br>Peekskill, NY 10566 | Pit | Do. |
| Garnet: | | | |
| Barton Mines Corp | North Creek, NY 12853 | Pit and plant | Warren. |
| Gypsum: | | | |
| Georgia-Pacific Corp | Box 105605<br>133 Peachtree St., NE.<br>Atlanta, GA 30348 | Plant | Westchester. |
| National Gypsum Co | 2001 Rexford Rd.<br>Charlotte, NC 28211 | do | Rensselaer. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | Underground mines and plants. | Genesee and Rockland. |
| Iron ore: | | | |
| NL Industries Inc | Tahawus, NY 12879 | Pit | Essex. |
| Lime: | | | |
| Allied Chemical Corp.[3] [4] | Box 70<br>Morristown, NJ 07960 | Quarry and plant. | Onondaga. |
| Peat: | | | |
| Good Earth Organics Corp | 5960 Broadway<br>Lancaster, NY 14086 | Bog | Cattaraugus. |
| Hyponex Corp | 20135 Anthony Blvd.<br>Fort Wayne, IN 46803 | Bog | Dutchess. |
| Perlite (expanded): | | | |
| Buffalo Perlite Corp | 100 Sugg Rd.<br>Buffalo, NY 14225 | Plant | Erie. |
| Solite International Corp | 6 Madison St.<br>Troy, NY 12181 | do | Rensselaer. |
| Salt: | | | |
| Cargill Inc | Box 5621<br>Minneapolis, MN 55440 | Underground mine. | Tompkins. |
| International Salt Co | Clarks Summit, PA 18411 | Underground mines. | Livingston and Schuyler. |
| Morton Thiokol Inc | 110 North Wacker Dr.<br>Chicago, IL 60606 | Well | Wyoming. |
| Sand and gravel: | | | |
| Broad Hollow Estates Inc | Box 483<br>Farmingdale, NY 11735 | Pit | Suffolk. |
| Buffalo Crushed Stone Inc | 861K Wherle Dr.<br>Williamsville, NY 14221 | Pits | Allegany and Cattaraugus. |
| McCormack Sand Co | Box 448<br>Port Washington, NY 11050 | Pit | Nassau. |
| Slag—iron: | | | |
| Buffalo Crushed Stone Corp.[3] | 2544 Clinton St.<br>Buffalo, NY 14216 | Plant | Erie. |

See footnotes at end of table.

## Table 6.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Stone (1983): | | | |
| Crushed: | | | |
| The General Crushed Stone Co., a subsidiary of Koppers Co. Inc. | Box 231<br>Easton, PA 18042 | Quarries | Herkimer, Jefferson, Livingston, Onondaga, Ontario, Wayne. |
| New York Trap Rock Corp., a subsidiary of Lone Star Industries Inc. | Box 432<br>Montvale, NJ 07645 | Quarry | Rockland. |
| Dimension: | | | |
| Heldeberg Bluestone & Marble Co | Box 36<br>East Berne, NY 12059 | Quarries | Albany and Delaware. |
| Hilltop Slate Co | Middle Granville, NY 12849 | Quarry | Washington. |
| Johnson & Rhodes Bluestone Co | East Branch, NY 13756 | do | Delaware. |
| Lake Placid Granite Co | 202 South 3d Ave.<br>Cold Spring, MN 56320 | do | Essex. |
| Medina Sandstone Quarry Inc | 8875 Quarry Rd.<br>Niagara Falls, NY 14304 | do | Orleans. |
| Ritchie Bros. Slate Co. Inc | Main St.<br>Middle Granville, NY 12849 | Quarries | Washington. |
| Stone Culture Inc | Box 43, Route 111<br>Alcove, NY 12007 | do | Albany. |
| Talc: | | | |
| Gouverneur Talc Co. Inc., a subsidiary of R. T. Vanderbilt Co. Inc. | Box 89<br>Gouverneur, NY 13642 | Underground mine. | St. Lawrence. |
| Wollastonite: | | | |
| NYCO Div. of Processed Minerals Inc.[5] | Box 368<br>Willsboro, NY 12996 | Surface mine | Essex. |
| R. T. Vanderbilt Co. Inc | 30 Winfield St.<br>Norwalk, CT 06855 | Underground mine. | Lewis. |
| Zinc: | | | |
| St. Joe Resources Co.[6] | 7733 Forsyth Blvd.<br>Clayton, MD 63105 | Underground mines. | St. Lawrence. |

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[1] Also synthetic mullite and synthetic graphite.
[2] Also clays.
[3] Also stone.
[4] Also salt.
[5] Also garnet.
[6] Also byproduct lead and silver.

# The Mineral Industry of North Carolina

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Division of Land Resources, North Carolina Department of Natural Resources and Community Development, for collecting information on all nonfuel minerals.**

**By Doss H. White, Jr.,[1] and P. Albert Carpenter III[2]**

The value of nonfuel mineral production in North Carolina reached $451.5 million in 1984. Mineral sales established a new record—$52.9 million over the previous high noted in 1983.

Production increased for every mineral commodity mined or manufactured in the State excluding talc and pyrophyllite. North Carolina led the Nation in the output of feldspar, mica, olivine, pyrophyllite, and lithium (spodumene) and ranked second in common clay, crushed granite, and phosphate rock.

**Table 1.—Nonfuel mineral production in North Carolina[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | [2]2,068 | [2]$6,681 | 2,327 | $8,987 |
| Feldspar short tons | 508,641 | 13,610 | 510,275 | 13,994 |
| Gem stones | NA | 50 | NA | 50 |
| Mica (scrap) thousand short tons | 69 | 4,266 | 79 | 3,762 |
| Sand and gravel: | | | | |
| Construction do. | [e]5,600 | [e]16,900 | 6,312 | 18,159 |
| Industrial do. | 1,066 | 11,689 | 1,158 | 12,864 |
| Stone: | | | | |
| Crushed do. | 33,694 | [r]145,001 | [e]38,100 | [e]168,000 |
| Dimension do. | 87 | 8,267 | W | W |
| Talc and pyrophyllite do. | 89 | 1,452 | 87 | 1,587 |
| Combined value of cement, clays (kaolin, 1983), lithium compounds, olivine, peat, phosphate rock, and value indicated by symbol W | XX | 190,641 | XX | 224,077 |
| Total | XX | [r]398,557 | XX | 451,480 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes kaolin; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in North Carolina, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Alamance | $104 | W | Stone (crushed), clays. |
| Anson | W | W | Sand and gravel (industrial), stone (crushed). |
| Ashe | (2) | $902 | Stone (crushed). |
| Avery | W | 1,452 | Stone (crushed), clays, mica. |
| Beaufort | W | W | Phosphate rock. |
| Bertie | W | (3) | |
| Bladen | 51 | (3) | |
| Buncombe | 740 | W | Stone (crushed). |
| Burke | 27 | W | Do. |
| Cabarrus | W | W | Stone (crushed), clays. |
| Caldwell | W | W | Stone (crushed). |
| Camden | 4 | (3) | |
| Caswell | (2) | W | Stone (crushed). |
| Catawba | (2) | W | Do. |
| Chatham | 940 | 1,386 | Clays. |
| Cherokee | W | W | Stone (crushed), talc. |
| Chowan | W | (3) | |
| Cleveland | 30,367 | 22,847 | Lithium, stone (crushed), feldspar, mica, sand and gravel (industrial), clays. |
| Craven | W | W | Stone (crushed). |
| Cumberland | 643 | (3) | |
| Currituck | W | (3) | |
| Dare | W | (3) | |
| Davidson | W | W | Stone (crushed), stone (dimension), clays. |
| Davie | 212 | W | Stone (crushed). |
| Duplin | (2) | W | Do. |
| Durham | W | W | Stone (crushed), clays. |
| Edgecombe | 275 | W | Stone (crushed). |
| Forsyth | (2) | W | Do. |
| Franklin | W | (3) | |
| Gaston | 41,233 | W | Lithium, stone (crushed), mica, feldspar. |
| Granville | -- | W | Olivine. |
| Greene | W | (3) | |
| Guilford | W | W | Stone (crushed), clays. |
| Halifax | W | W | Clays. |
| Harnett | W | W | Stone (crushed), sand and gravel (industrial), clays. |
| Haywood | 1,010 | 1,281 | Stone (crushed). |
| Henderson | W | W | Stone (crushed), clays. |
| Hertford | W | (3) | |
| Hyde | 95 | W | Peat. |
| Iredell | W | W | Stone (crushed), clays. |
| Jackson | W | W | Olivine, stone (crushed). |
| Johnston | W | W | Stone (crushed). |
| Jones | (2) | 70 | Do. |
| Lee | 456 | W | Stone (crushed), clays. |
| Lenoir | W | (3) | |
| McDowell | 430 | 137 | Stone (dimension). |
| Macon | W | (3) | |
| Martin | 14 | (3) | |
| Mecklenburg | (2) | W | Stone (crushed). |
| Mitchell | 11,149 | 16,372 | Feldspar, stone (crushed), mica, olivine, stone (dimension). |
| Montgomery | W | W | Stone (dimension), clays. |
| Moore | 807 | W | Talc, clays. |
| New Hanover | W | W | Stone (crushed), cement. |
| Northampton | W | (3) | |
| Onslow | (2) | W | Stone (crushed). |
| Orange | W | W | Stone (crushed), talc. |
| Pasquotank | W | (3) | |
| Pender | (2) | W | Stone (crushed). |
| Pitt | 244 | W | Do. |
| Polk | -- | W | Stone (dimension). |
| Randolph | (2) | W | Stone (crushed). |
| Richmond | W | W | Sand and gravel (industrial), stone (crushed). |
| Rockingham | W | 2,273 | Stone (crushed), clays. |
| Rowan | W | W | Stone (crushed), clays, stone (dimension). |
| Rutherford | (2) | W | Stone (crushed). |
| Sampson | -- | 24 | Clays. |
| Scotland | W | (3) | |
| Stanly | 513 | 845 | Clays. |
| Stokes | 125 | 99 | Do. |
| Surry | W | W | Stone (dimension), stone (crushed). |
| Swain | (2) | W | Stone (crushed). |
| Transylvania | (2) | W | Do. |
| Tyrrell | 3 | (3) | |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in North Carolina, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Union | $243 | W | Stone (crushed), clays. |
| Vance | (2) | W | Stone (crushed). |
| Wake | W | W | Stone (crushed), clays. |
| Washington | 28 | $22 | Peat. |
| Watauga | (2) | 2,084 | Stone (crushed), stone (dimension). |
| Wayne | 357 | (3) | |
| Wilkes | (2) | W | Stone (crushed). |
| Wilson | (2) | W | Do. |
| Yadkin | W | (3) | |
| Yancey | W | W | Olivine, mica. |
| Undistributed[4] | 88,953 | 331,864 | |
| Sand and gravel (construction) | XX | [e]16,900 | |
| Stone: | | | |
| Crushed | [e]117,600 | XX | |
| Dimension | [r] [e]8,457 | XX | |
| Total[5] | [r]305,079 | 398,557 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to totals shown because of independent rounding.

## Table 3.—Indicators of North Carolina business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 6,019 | 6,076 | 6,165 |
| Total civilian labor force | do | 2,945 | 2,935 | 3,033 |
| Unemployment | do | 266 | 261 | 205 |
| Employment (nonagricultural): | | | | |
| Mining total | do | 4.6 | 4.3 | 4.6 |
| Manufacturing total | do | 782.2 | 796.1 | 830.6 |
| Primary metal industries | do | 8.7 | 9.3 | 10.9 |
| Stone, clay, and glass products | do | 16.0 | 16.9 | 18.7 |
| Chemicals and allied products | do | 38.1 | 37.9 | 38.2 |
| Petroleum and coal products[1] | do | .7 | .7 | NA |
| Construction | do | 106.8 | 112.4 | 133.0 |
| Transportation and public utilities | do | 114.7 | 120.5 | 127.5 |
| Wholesale and retail trade | do | 482.7 | 508.0 | 549.3 |
| Finance, insurance, real estate | do | 97.8 | 100.4 | 104.9 |
| Services | do | 357.9 | 370.4 | 398.2 |
| Government and government enterprises | do | 400.3 | 407.1 | 413.7 |
| Total | do | 2,347.0 | 2,419.2 | 2,561.8 |
| Personal income: | | | | |
| Total | millions | $55,005 | $59,778 | $66,891 |
| Per capita | | $9,138 | $9,839 | $10,850 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 37.3 | 40.0 | 39.9 |
| Mining | | 41.3 | 39.7 | 42.7 |
| Total average hourly earnings, production workers | | $6.35 | $6.68 | $7.01 |
| Mining | | $6.79 | $7.15 | $7.74 |
| Earnings by industry: | | | | |
| Farm income | millions | $1,354 | $1,100 | $1,651 |
| Nonfarm | do | $39,723 | $43,874 | $49,218 |
| Mining total | do | $90 | $94 | $108 |
| Manufacturing total | do | $13,256 | $14,883 | $16,456 |
| Primary metal industries | do | $202 | $242 | $297 |
| Stone, clay, and glass products | do | $303 | $341 | $422 |
| Chemicals and allied products | do | $932 | $982 | $1,060 |
| Petroleum and coal products | do | $16 | $20 | $22 |
| Construction | do | $1,886 | $2,129 | $2,648 |
| Transportation and public utilities | do | $2,978 | $3,304 | $3,612 |
| Wholesale and retail trade | do | $6,400 | $6,914 | $7,671 |
| Finance, insurance, real estate | do | $1,707 | $1,974 | $2,183 |
| Services | do | $5,761 | $6,461 | $7,423 |
| Government and government enterprises | do | $7,517 | $7,967 | $8,656 |

See footnotes at end of table.

Table 3.—Indicators of North Carolina business activity —Continued

| | 1982r | 1983 | 1984p |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 33,326 | 54,762 | 57,081 |
| Value of nonresidential construction millions | $886.7 | $1,438.1 | $1,641.6 |
| Value of State road contract awards do | $145.6 | $202.5 | $403.5 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,532 | 1,668 | 1,948 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $305.1 | $398.6 | $451.5 |
| Value per capita | $50 | $66 | $73 |

pPreliminary. rRevised. NA Not available.
[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

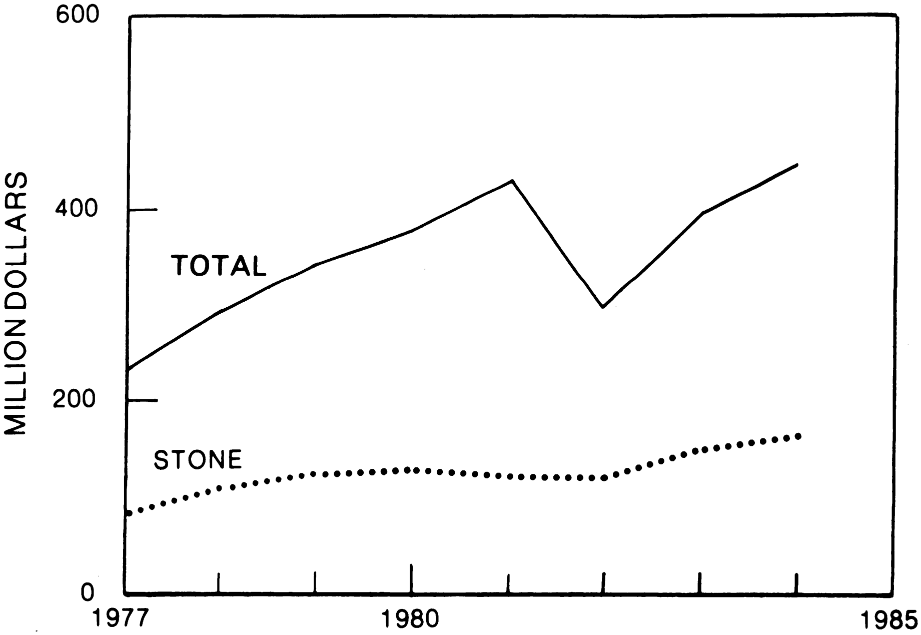

Figure 1.—Value of stone and total value of nonfuel mineral production in North Carolina.

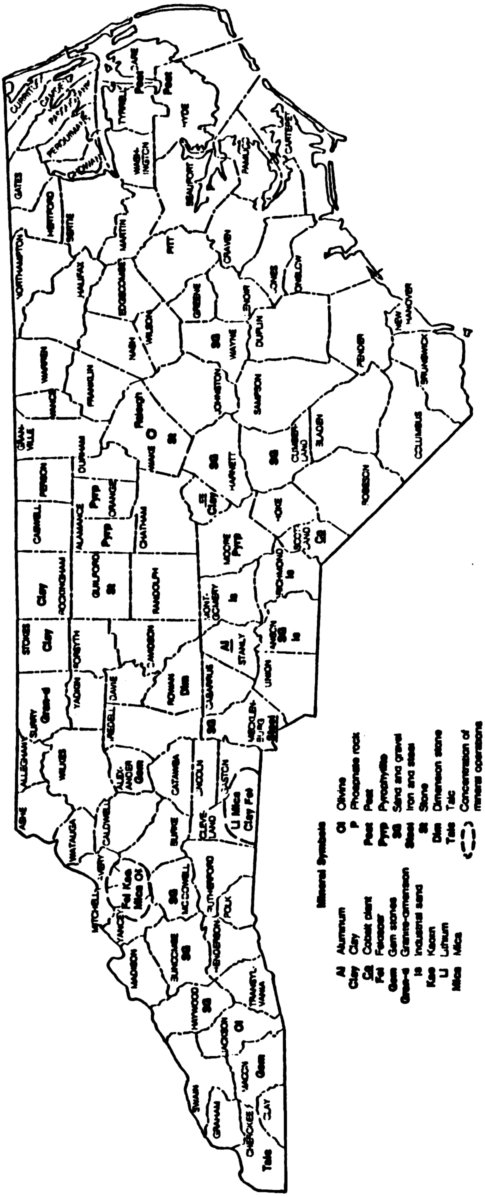

Figure 2.—Principal mineral producing localities in North Carolina.

**Trends and Developments.**—The trend of increased demand for North Carolina's mineral production continued into the second consecutive year. The construction industry, which uses a large portion of the State's extractive mineral output in the manufacture of brick, clays, concrete, glass, mortar, paint, tile, wallboard joint compound, and many other related products, experienced a strong year as noted in table 3. This strength in mineral utilization in conjunction with a strong demand for mineral raw materials used by industry in the manufacture of fertilizer, fillers and extenders, grease, insecticide carriers, plastics, refractories, rubber, and a myriad of other products, combined to raise the value of North Carolina's mineral output to a new record-high.

The major developments during 1984 relating to the mineral industry involved peat, phosphate, and pollution.

Plans for a controversial $540 million peat-to-methanol plant proposed for a Washington County site were terminated in February when the Synthetic Fuels Corp., a Federal agency, refused additional funding for the project. The project, which would have mined up to 115,000 acres of peat, was opposed by several scientific, environmental, and commercial groups.

Early in the year, geologists at the University of North Carolina announced the results of a 4-1/2-year investigation into the State's peat reserves. The study, funded by $450,000 in grants from the U.S. Department of Energy and the North Carolina Energy Institute, found that reserves totaled approximately 530 million short tons of harvested and dried peat. This was significantly below an earlier study that established the State's fuel-grade peat reserves at 2 billion tons.

In April, Carolina Methane Inc. announced plans to apply for the necessary permits to construct a test facility to extract methane dissolved in water within the peat beds. Methane would be extracted in a vacuum chamber and the water returned to the beds.

Later in the year, Carolina Co-generation announced tentative plans to construct a peat-fired power generator facility in the New Bern area if necessary permits could be obtained.

With the improvement in the international economy, the demand for fertilizer increased. This had a positive effect on the two phosphate companies located in-State. Texasgulf Inc. announced plans to expand the Lee Creek fertilizer complex and Morehead City Port facilities. North Carolina Phosphate Corp. continued work on its Canvas Creek phosphate mine and beneficiation-calcining complex adjacent to the Texasgulf operation. The company was also engaged in preconstruction studies on a $31 million phosphate handling facility at Morehead City Port. North Carolina Phosphate and the State Port Authority finalized the project in December 1983.

Pollution, in the form of sediment eroded from abandoned feldspar, mica, and clay mines in Avery, Mitchell, and Yancey Counties, has washed into the North and South Toe and Nolichucky Rivers in western North Carolina. These rivers feed several Tennessee Valley Authority (TVA) reservoirs in eastern Tennessee, and in 1972, TVA was forced to abandon the hydroelectric facilities at Davy Crockett Lake when turbine intakes were covered by sediment. Sediment also threatens the water supply for Greeneville and Jonesboro, TN.

In 1981 and 1982, TVA and the State of North Carolina inventoried the abandoned mines in the three-county area and determined those areas contributing sediment to the waterways. The study identified 155 mines covering almost 1,500 acres; 607 acres were eroding and needed reclaiming. At the beginning of 1984, approximately 250 acres had been reclaimed and 357 acres remained.

In 1984, the North Carolina General Assembly appropriated $48,000 to be shared by the three counties for continued reclamation work; the counties were required to provide matching funds. A special $8,000 appropriation was voted for Yancey County, which will decrease matching fund requirements by 50%. Officials in Avery and Mitchell Counties contended the action would provide a hardship and questioned counties having to fund an environmental problem that was actually a State environmental issue.[3]

In other developments, the Interstate Mining Compact Commission scheduled the 1985 annual meeting for September at a conference center in Asheville.

The International Association of Common Surface Mining Equipment Troubleshooters (COSMET) held a 3-day meeting at New Bern and toured Texasgulf's phosphate operation at Lee Creek, Beaufort County. COSMET members were from Australia, Canada, Guyana, the Republic of South Africa, and the United States. In the United States, 3 of the 30 large draglines are in Beaufort County.

In July, scientists and government personnel from 10 Central American countries met at East Carolina University for an intensive overview of how phosphate could provide jobs and food for Latin America. The 6-day conference covered a variety of topics, including phosphate formation and exploration. Participants toured the Texasgulf phosphate mine in Beaufort County.

The Materials Engineering Department at North Carolina State University was actively reseaching fiber-reinforced composites. The properties and interaction of several mineral commodities have been under investigation; among these are glass, graphite, mica, and silicon carbide. The department was also working with nickel aluminide alloys and was prominent in the development of "synroc," a synthetic rock with applications in radioactive materials storage.[4]

**Exploration Activities.**—Several companies were actively engaged in exploration work, primarily for gold, during all or part of 1984. A number of these are summarized as follows:

| Company | Area | Remarks |
|---|---|---|
| Billiton Metals and Ores Inc | Western Piedmont | Conducted tin exploration program. |
| Cominco American Incorporated. | Union County | Dewatered and sampled Howie Mine. |
| Easter Mining Management | Person County | Applied for gold mining permit. |
| Gold Fields Mining Corp. | Gold Hill district, Randolph County. | Core drilling and sampled Sawyer Mine. |
| Petromet Resources Ltd | Franklin County | Drilled and trenched Portis Mine. |
| Tenneco Minerals Co. | Montgomery County | Drilled and geophysical work at Russel Mine. |
| Texasgulf Minerals and Metals Corp. | Cleveland County | Drilled Kings Mountain Mine. |

**Legislation and Government Programs.**—In its 1984 session, the North Carolina General Assembly passed an act regulating the practice of geology. The Geologist Licensing Act requires individuals who publicly practice geology to meet minimum educational qualifications and pass a licensing examination.

The General Assembly also authorized $16,000 for abandoned mine land reclamation for Avery, Mitchell, and Yancey Counties. The counties were required to provide matching funds.

The North Carolina Geological Survey (NCGS), a section of the Division of Land Resources, consists of several programs: (1) Geological Survey, (2) Geodetic Survey, (3) Land Quality, (4) Earth Resource Planning, and (5) Land Resources Information Series.

The Geological Survey Section is concerned with the investigation, evaluation, conservation, and development of North Carolina's land and mineral resources. During 1984, work continued on the production of a new State geologic map, scale 1:500,000, projected for publication in the fall of 1985. The NCGS continued its cooperative 7.5-minute topographic map program with the U.S. Geological Survey, and the State will have complete coverage by the end of 1986.

The North Carolina Mineral Laboratory in Asheville, part of the University of North Carolina system, ranks among the top minerals beneficiation research organizations in the world. During 1984, the laboratory conducted research into the evaluation and beneficiation of several minerals and ores. Among these were barite, feldspar, glass sand, kaolin, marble, olivine, phosphate, quartz, spodumene, talc, and zinc.

The U.S. Bureau of Mines conducted several programs relating to North Carolina's mineral production. During the year, all mineral producers in the State were canvassed to develop baseline data on mineral production and value. This was part of a nationwide program to track domestic mineral production and determine demand, mineral trends, and possible areas of shortage before the shortages occur.

Bureau research personnel, in conjunction with Atlas Powder Co., conducted a number of production blasts at the Central Rock Granite Quarry at Greensboro to determine relationships between blast initiation and efficient fragmentation.

Dewatering tests were conducted on clay wastes generated by a North Carolina mica producer. Based on the Bureau of Mines test results, the company installed a dewatering unit to mitigate the waste problem.

A report released in July by the General Accounting Office noted that although the Federal Government had some regulatory control, it could not deny development of private mineral rights in Federal wilderness areas. In North Carolina, most of the wilderness areas are in the western part of the State in the Nantahala, Pisgah, and Uwharrie National Forests. Private mineral rights in North Carolina's wilderness areas are summarized as follows:[5]

| Wilderness area | Approximate acreage | Approximate acreage of private mineral rights |
|---|---|---|
| Shining Rock | 5,100 | 4,200 |
| Middle Prong | 7,900 | 4,000 |
| Lineville Gorge | 10,975 | 300 |
| Southern Nantahala | 10,900 | 700 |
| Birkhead Mountains | 4,790 | 700 |

The U.S. Forest Service controls the surface rights in the wilderness areas and can control access to an area, requiring exploration equipment to be moved to the property by helicopter if it is believed access roads could not be adequately reclaimed.

During the year, the U.S. Congress passed the North Carolina Wilderness Bill, which expanded wilderness holdings in the State.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

North Carolina's mineral industry reported record high sales as the demand for the State's mineral commodities, the raw materials for many of the Nation's manufacturing industries, continued to grow for the second consecutive year. Industrial mineral production increased $52.9 million in value over that reported in 1983.

**Cement.**—The State's only cement plant, located at Castle Hayne and owned by Ideal Basic Industries Inc., closed late in 1982. High energy costs and a decrease in construction activity were cited as reasons for the 1982 closing. Early in 1984, Moore McCormack Cement Inc. purchased the Castle Hayne facility, a cement terminal at Statesville, and a cement bulk transfer facility in Wilmington.

**Clays.**—For the second consecutive year, the value of clay production increased over that reported for the previous year and was within $1.2 million of the record high $9.1 million established in 1978. The strong showing by the State's construction industry was the principal reason for the increase in the sales of clay products.

In 1984, the North Carolina clay industry consisted of 19 companies operating 53 pits in 25 of the State's 100 counties. All but two of the mines produced common clay used in the manufacture of brick and other structural clay products. Two companies, Kings Mountain Mica Co. in Kings Mountain and Harris Mining Co. in the Spruce Pine area, recovered kaolin during mica beneficiation. Kaolin sales, in descending order of quantity, were to the insulator, ceramic, and specialty brick industries.

**Table 4.—North Carolina: Common clay and shale sold or used by producers, by county**

| County | 1983 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (short tons) | Value | Number of mines | Quantity (short tons) | Value |
| Alamance | 2 | 70,122 | $184,842 | 2 | 72,487 | $199,339 |
| Buncombe | -- | -- | -- | 4 | 56,000 | 150,000 |
| Cabarrus and Durham | 3 | 297,926 | 1,196,629 | 5 | 331,916 | 1,533,705 |
| Chatham | 3 | 270,500 | 1,385,960 | 3 | 317,094 | 1,155,847 |
| Iredell and Rockingham. | 3 | 230,908 | 416,664 | 9 | 228,849 | 417,100 |
| Lee and Stanly | 6 | 532,030 | 1,345,005 | 6 | 504,704 | 1,302,837 |
| Montgomery,[1] Hanover, Guilford, Davidson | 6 | 144,065 | 297,919 | 5 | 165,628 | 389,120 |
| Rowan | 4 | 156,297 | 953,416 | 4 | 221,299 | 1,380,718 |
| Sampson | 1 | W | W | 1 | 14,000 | 16,800 |
| Stokes | 1 | 35,538 | 98,796 | 1 | 35,538 | 98,796 |
| Union | 1 | 157,467 | 330,681 | 1 | 181,184 | 815,328 |
| Undistributed[2] | 5 | 173,094 | 471,047 | 6 | 151,935 | 451,503 |
| Total | 35 | 2,067,947 | 6,680,959 | 47 | 2,280,634 | 7,911,093 |

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Montgomery data for 1983 only.

[2] Includes Halifax, Harnett, Henderson, Moore, and Wake Counties and data indicated by symbol W.

Brick sales increased for the second consecutive year and for the first half of the year were 26% above those of 1983 and 60% above the 1982 sales level.

During 1984, Pine Hall Brick & Pipe Co. of Winston-Salem purchased the stock of Redford Brick Co. and Redford Brick Sales Co. of Richmond, VA. Redford Brick, which was founded in 1871, is the oldest continuously operating brick company in the United States. The company's market area is the Richmond and Tidewater areas of Virginia.

Triangle Brick Co. of Durham completed a major reconstruction of the plant's unloading and packaging system.

Duramic Products Inc. announced plans for a 4,000-square-foot expansion to its existing facility. The addition will house computer-operated equipment for three-axis contouring and for machining of ceramics to any configuration or geometric shape.[6]

**Feldspar.**—The State again led the Nation in the production of feldspar, an aluminum silicate of varying chemical composition used in the manufacture of ceramics and glass. North Carolina produced 72% of the Nation's total; output increased 1,634 short tons over the level produced in 1983 but was 13,400 tons below the record high production of 1979.

Although an increase in construction activity and automobile sales increased the demand for flat glass, container glass producers faced strong competition from plastic bottles. Feldspar producers also faced competition in the Northeast from nepheline syenite, a feldspar substitute produced in Canada.

Alaskite, an ore that contains approximately 65% feldspar, is mined in the Spruce Pine area by three companies. All three companies used a three-phase flotation process to separate mica, iron minerals, and silica from the feldspar concentrate. One company upgraded the silica into a high-purity industrial silica product. Feldspar concentrates were dried and shipped in bag or bulk to glass producers throughout the United States and in several foreign countries. A pottery-grade product was produced by removing iron minerals using magnetic separation followed by dry grinding.

A mica producer and two lithium producers in the Kings Mountain-Cherryville area recovered feldspar concentrates during mica and/or lithium beneficiation. Kings Mountain Mica recovered feldspar concentrates during mica flotation and from feldspar-silica tailings purchased from Foote Mineral Co. Foote Mineral recovered the concentrate during lithium (spodumene) beneficiation. Lithium Corp. of America Inc. (Lithcoa) recovered a feldspar-silica concentrate during lithium beneficiation, and the concentrate was trucked to Pacolet, SC, for grinding.

**Table 5.—North Carolina: Feldspar industry in 1984**

| Company | Location | Ore type | Comments |
|---|---|---|---|
| Primary producers: | | | |
| The Feldspar Corp | Spruce Pine | Alaskite | Byproduct mica and construction-grade sand. |
| Indusmin Inc | do | do | Do. |
| International Minerals & Chemical Corp. | do | do | Byproduct mica and industrial-grade sand. |
| Secondary producers: | | | |
| Foote Mineral Co | Kings Mountain | Spodumene-rich pegmatite. | Feldspar-silica concentrate from flotation cells. |
| Kings Mountain Mica Co. Inc | do | Mica-rich pegmatite | Byproduct with mica, clay, and silica recovery. |
| Lithium Corp. of America Inc | Cherryville | Spodumene-rich pegmatite. | Feldspar-silica concentrate from flotation cells. |

**Gem Stones.**—The State ranked first in the Eastern United States in the number of mines and businesses producing or selling gem stones and mineral specimens. Several score small mining operations in the western and southwestern parts of the State were open to the hobbyist and provided the opportunity to collect a variety of precious and semiprecious stones at a minimal cost.

In July, Franklin, in the southwestern part of the State, held its 19th annual Gemboree. Sponsored by the Franklin Area

Chamber of Commerce and the Gem and Mineral Society of Franklin, the Gemboree has contributed to Franklin's image as the "Gem Capital of the World." Cowee Valley, the principal gem-bearing area in the State, is a few miles from Franklin.

Principal gem stones and gem stone areas in the western part of North Carolina are as follows:

| County | Nearest city | Principal gem stones |
|---|---|---|
| Alexander | Hiddenite | Emeralds and hiddenite. |
| Macon | Franklin | Rubies, sapphires, garnets. |
| Mitchell | Spruce Pine | Emeralds and aquamarine. |

A large mineral collection was donated to Gardner-Webb College in Boiling Springs. The collection contains specimens from many worldwide locations, as well as several rare minerals from North Carolina.

**Graphite (Synthetic).**—Two companies, Great Lakes Carbon Corp. at Morganton and Morganite Inc. at Dunn, manufactured a variety of products from synthetic graphite. During the year, Great Lakes was sold to Horsehead Industries Inc. of New York, a 700-employee firm that produces anodes, electrodes, crucibles, and graphite vessels.

Morganite produced carbon seals and brushes. The company, a subsidiary of London-based Morgan Crucible Co. PLC, increased output approximately 50% over that of 1983, and sales were about $50 million.[7]

**Gypsum.**—National Gypsum Co. operated a wallboard manufacturing plant in Wilmington. Crude gypsum, the basic raw material, was obtained by ship from company mines in Canada.

Texasgulf produced a byproduct gypsum during phosphoric acid manufacture at the fertilizer complex at Lee Creek. Although a limited tonnage was used by local farmers as a soil conditioner, a tremendous tonnage has accumulated since the operation began. With the current disposal system, dozers and backhoes load gypsum onto a conveyor system that moves it to two 85-foot-diameter clay-blending tanks. The mixture is then piped to the mine and used as backfill.[8]

**Lithium.**—North Carolina continued to lead the world in the output of lithium minerals; the lithium industry is in the Kings Mountain-Cherryville area in the southwestern part of the State. Foote Mineral at Kings Mountain and Lithcoa at Cherryville both mined a spodumene-bearing pegmatite by open pit methods. Lithcoa also produces lithium metal. A portion of Foote Mineral's lithium carbonate output is shipped to company plants in Sunbright, VA, Frazer, PA, and New Johnsonville, TN, for lithium chemical manufacture. Lithcoa's production was sold on the open market. Major markets were the aluminum, glass, and grease industries.

**Mica.**—In 1984, North Carolina mica producers accounted for 53% of the value and 49% of the tonnage produced in the Nation. Production increased 10,000 short tons but value fell $500,000 below that of 1983.

The industry produced both wet and dry ground mica; the former was used primarily in paint manufacture while the latter found application in wallboard joint cement and in oil well drilling mud. Several companies processed mica purchased from other sources, and two firms fabricated mica shapes from imported mica.

**Table 6.—North Carolina: Mica industry in 1984**

| Company | Location | Grinding process | Comments |
|---|---|---|---|
| Producers (mica): | | | |
| Deneen Mica Co | Spruce Pine | Dry | Primary mica. |
| The Feldspar Corp | Kings Mountain | XX | Byproduct mica; sold to United States Gypsum Co. |
| Foote Mineral Co | do | XX | Byproduct mica; sold to Asheville Mica Co. |
| Harris Mining Co | Spruce Pine | Dry | Primary mica. |
| J. M. Huber Corp | do | Wet | Processes mica schist and scrap from mica fabricators. |
| Indusmin Inc | do | XX | Byproduct mica; sold to Harris Mining Co. |
| International Minerals & Chemical Corp. | do | XX | Do. |

See footnote at end of table.

Table 6.—North Carolina: Mica industry in 1984 —Continued

| Company | Location | Grinding process | Comments |
|---|---|---|---|
| Producers (mica) —Continued | | | |
| Kings Mountain Mica Co | Kings Mountain | Dry and wet | Primary mica. |
| Lithium Corp. of America Inc | Cherryville | XX | Byproduct mica; sold to various firms. |
| Producers (sericite): | | | |
| Piedmont Minerals Co | Hillsboro | XX | Sold to brick and ceramics industries. |
| Processors of purchased mica: | | | |
| Asheville Mica Co | Asheville | Dry | Mica received from Georgia. |
| Franklin Mineral Co | Franklin | Wet | |
| United States Gypsum Co | Spruce Pine and Kings Mountain. | Dry | |
| Fabricators: | | | |
| Spruce Pine Mica Co | Spruce Pine | XX | Mica obtained from foreign sources. |
| Tar Heel Mica Co | Plumtree | XX | Do. |

XX Not applicable.

Kings Mountain Mica completed a $250,000, 100-short-ton-per-day spiral separation mica plant; Harris Mining completed construction of a mica schist flotation plant; and Asheville Mica Co. completed a new mica warehouse facility.

At yearend, J. M. Huber Corp. had applied for mining permits for a new mine in the Kings Mountain area. Industry sources have noted that when the Huber mining-processing complex is completed it will lead the world in new beneficiation technology.

Table 7.—North Carolina: Ground mica sold or used by producers, by use

| Use | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity (short tons) | Value | Quantity (short tons) | Value |
| Paint | 6,603 | $2,238,100 | W | W |
| Joint cement | 38,523 | 6,344,452 | 43,635 | $7,298,227 |
| Other[1] | 21,549 | 4,643,643 | 33,080 | 7,639,437 |
| Total | 66,675 | 13,226,195 | 76,715 | 14,937,664 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes insulation, plastics, textile coatings, wallpaper, welding rods, well drilling, other miscellaneous uses, and use indicated by symbol W.

**Olivine.**—North Carolina and Washington were the only States with an extractive olivine industry. During 1984, output and value reported by the State's three producers increased 56% and 43%, respectively, over those of 1983. The State's olivine industry consisted of three companies operating four plants and six mines.

Approximately 90% of International Minerals & Chemical Corp.'s (IMC) output, which was sold under the trade name Oliflux, was used in blast furnace application. The company also produced foundry sand. Spruce Pine Olivine Co.'s material was sold as lump aggregate for slag conditioning and to the manufacturer of magnesium pellets. National Olivine Co. production was used by a variety of customers; approximately 60% of the company's output was sold to the steel industry. End products included foundry sand, sandblasting aggregate, in steel rolling mill soaking pits, refractory backing for tundish linings, and lump olivine for blast furnace use.

A small tonnage was exported to South America for steel soaking pit applications. National Olivine declared bankruptcy in December.

**Phosphate Rock.**—North Carolina ranked second following Florida in phosphate rock production. In 1984, Texasgulf operated a mining, beneficiation, and phosphoric acid complex at Lee Creek in Beaufort County. Dredges and draglines stripped the overburden and draglines mined the ore, which was slurried to a beneficiation plant where flotation was used to produce a phosphate rock concentrate for the production of phosphoric acid. The complex houses the world's largest sulfuric acid plant.

In July, the company announced plans to expand annual output by 250,000 short tons of phosphoric acid. The expansion, to be accomplished by increasing the efficiency of existing facilities and adding some new equipment, will raise the capacity of the complex to 1.27 million tons per year. A completion date in 1986 was announced. In addition to phosphate rock and phosphoric acid, the Lee Creek complex produced superphosphoric acid, ammonium phosphate, and granular triple superphosphate.

Texasgulf also operated a calcium phosphate animal feed supplement manufacturing facility at Kingston.

In support of the Lee Creek expansion, the company leased an additional 3 acres from the North Carolina State Ports Authority at the Morehead City Port facility. The company planned to construct bulk unloading facilities for rail cars and barges.

At yearend, Texasgulf had requested a $9 million tax-free bond issue, and the industrial bond sale had been approved at county level.

North Carolina Phosphate, owned by Agrico Chemical Co., continued work on the State's second phosphate mine adjacent to the Texasgulf operation. The 3.7-million-short-ton-per-year Canvass Creek Mine is scheduled for production in 1987, 2 years behind the initial schedule. Bucket wheel excavators and draglines will be used to strip and mine the phosphate rock, which will be calcined on-site and shipped by barge to the Morehead City Port for foreign export.

**Pyrophyllite.**—In 1984, North Carolina and California were the only States with pyrophyllite production. Pyrophyllite, a hydrous aluminum silicate, is used as an extender and/or filler in a variety of products and in the production of refractory shapes.

Standard Minerals Co. Inc. and Glendon Pyrophyllite Inc., both with surface mines and processing facilities in Moore County, produced a product used as an insecticide filler and carrier, wallboard and latex foam filler, and refractory material.

Piedmont Minerals Co., Orange County, produced an andalusite pyrophyllite concentrate by surface mining and heavy media beneficiation. Piedmont was experimenting with the addition of a second-stage heavy media separation step to upgrade the plant's output. Concentrate from the Orange County operation was trucked to Greensboro for refractory manufacture. Sericite and quartzite are recovered during the mining operation and marketed as a brick clay additive and for aggregate.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

About 50% of the State's construction sand and gravel production came from 4 areas in 10 counties. These included, in descending order of tonnage: (1) Cumberland and Harnett Counties; (2) Anson, Montgomery, and Richmond Counties; (3) Buncombe, McDowell, and Yancey Counties; and (4) Cabarrus County.

**Table 8.—North Carolina: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 1,941 | $6,235 | $3.21 |
| Plaster and gunite sands | 326 | 584 | 1.79 |
| Concrete products | 185 | 669 | 3.61 |
| Asphaltic concrete | 1,069 | 3,668 | 3.43 |
| Road base and coverings | 851 | 2,297 | 2.70 |
| Fill | W | W | 1.31 |
| Snow and ice control | W | W | 2.27 |
| Other[1] | 1,939 | 4,707 | 2.43 |
| Total[2] or average | 6,312 | 18,159 | 2.88 |

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1] Includes other unspecified uses and uses indicated by symbol W.
[2] Data do not add to totals shown because of independent rounding.

*Industrial.*—Industrial sand and gravel was produced by seven companies operating seven mines in five counties. Approximately 90% of the output reported was from the Anson-Richmond Counties contiguous area in south-central North Carolina. Mines in Cleveland, Harnett, and Mitchell Counties supplied the remainder.

Production and value data were reported by six companies operating six mines. Output increased 92,000 short tons and value was up almost $1.2 million above the 1983 level. Over 50% of the production was used in the manufacture of flat and container glass. Other specified uses, in descending tonnages, were for the manufacture of ferrosilicon, filtration uses, sandblasting medium, and for traction sand.

Unimin Corp. began construction of a $6 million silica flour facility at Marston. Several grades of ground silica will be produced for the chemical, fillers, and fiberglass industries. The plant, designed for future expansion, is scheduled for completion in the first quarter of 1985.

IMC continued construction to expand its high-purity quartz facility at the feldspar beneficiation complex near Spruce Pine. When completed, the expansion will allow IMC to triple production. Primary markets will be the semiconductor, refractory, and fiber-optics industry.

One of the State's oldest industrial sand and gravel producers, the Southern Products and Silica Co., is also one of the most diversified. The Hoffman-based operation marketed quartzite ranging from sand to pebble size for use in chemical plants as inert filters, tower packing converters, and other applications.

The Kerr Glass Manufacturing Corp. plant at Clinton was sold to National Can Co. The Clinton facility was one of four sold by Kerr; primary output at the plant was beverage bottles.

Libby Owens Ford Co. announced plans to sell the glass coating, heat treating, and insulating glass fabricating plant at Clinton. This facility was one of six plants that the company planned to sell to concentrate on the clear, tinted, and coated float glass products for the construction and associated markets.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—The estimate of North Carolina's crushed stone production for 1984 totaled 38.1 million short tons, an increase of 4.4 million tons over that reported in 1983. The industry was represented by 36 companies with operations in 50 of the State's 100 counties.

Martin Marietta Corp.'s proposal to develop quarries in Cabarrus and Gaston Counties met with strong opposition from local residents. At yearend, the Cabarrus County Planning Board postponed a decision on granting the Midland Community Association another hearing on its petition to outlaw the "extraction of earth products" in most of the county.

In September, the Gaston County Commission passed a resolution requesting the North Carolina Department of Natural Resources and Community Development to deny a Martin Marietta mining permit. In June, the company's Raleigh-Durham quarry was presented (1) the top Showplace Award in the National Crushed Stone Association's "About Face" contest for 1983;

(2) the Governor's Award for Conservation in the mineral resources category, sponsored by the North Carolina Wildlife Federation; (3) the 1983 honor award for erosion control planning from the North Carolina Chapter of the American Society of Landscape Architects; and (4) the 1983 Grand Award for environmental improvement from the Association of Landscape Contractors.

Martin Marietta's quarry at Reidsville celebrated 25 years in July without a lost-time accident. The company presented employees with savings bonds.

Wake Stone Corp. completed the construction of a berm along property lines fronting I-40 to shield the 222-acre quarry site.

Hendrix Industries began production at its Lake Norman quarry and crushing plant north of Charlotte early in the year. The $6 million facility will provide stone for residential and commercial construction, road building, and stabilization for the central North Carolina market.

In December, the Dickerson quarry in Richmond County was permanently closed. The quarry and associated equipment, owned by the Dickerson Group Inc., are scheduled to be sold in 1985.

*Dimension.*—The dimension stone industry in North Carolina produced granite, sandstone, and argillite from surface quarries in the western part of the State. Granite output was centered in the northwestern part of the State where North Carolina Granite Corp. operates the world's largest granite quarry near Mount Airy. The company produces a myriad of stone products ranging from veneer and curbing to mausoleums and chicken grit. Dimension sandstone operations in the west-central part of the State produced stone slabs for building facing and patio applications. Jacobs Creek Stone Co. in Davidson County produced dimension argillite for both construction and monument uses.

Several small businesses in Cherokee, Macon, and Swain Counties shipped fieldstone to Florida markets. The stone, used for patio, wall, and fireplace construction, is shipped by truck in 24-ton loads.[9]

**Sulfur.**—Texasgulf signed an agreement with a Canadian petroleum company to buy approximately 200,000 metric tons of sulfur annually. The sulfur will be shipped to Texasgulf's Lee Creek fertilizer complex from the petroleum company's gas processing facility at Ram River and Windfall, Alberta, Canada. In 1984, Texasgulf received 50 railroad tank cars of sulfur each day; the sulfur is used in the manufacture of sulfuric acid.

During the year, Texasgulf agreed to close one of five sulfuric acid production plants because of potential problems with air pollution. Under an agreement between the company and State Environmental Management officials, Texasgulf will close the plant when a new facility with up-to-date pollution controls is built, or by December 1987, whichever comes first. A new plant is scheduled to be completed in August 1986. Although the current acid plant meets existing air pollution standards, computer predictions of "worst-case" conditions indicate the potential for the plant to exceed acceptable standards.[10]

**Talc.**—Warner Corp. operated the State's only underground mine in Murphy. The Cherokee County operation produced talc from deposits associated with the Murphy marble. Crude talc was milled into a cosmetic powder and sawed into talc pencils for the metals industry. Talc imports continued to have a serious negative impact on domestic talc demand and sales.

## METALS

Aluminum and steel are the principal primary metals produced in North Carolina, and 1984 was a disappointing year for the former though a rewarding year for the latter. Other metal producers experienced a mixed demand for their products. Imports proved to be the major problem faced by this segment of the minerals industry.

**Aluminum.**—Aluminum Co. of America (Alcoa) operates a 115,000-metric-ton-per-year smelter at Badin. Production at the Badin facility, operating at 100% capacity for the first 9 months of the year, was cut by 28,750 tons in September as the company removed one-half of a potline from production.[11]

At yearend, Alcoa wrote off $5 million in construction costs for a third potline at the Badin smelter that will not be completed.[12]

**Cobalt.**—Cobalt metal imported from Zaire was processed into extra-fine cobalt powder at a plant in Laurinburg in the southern part of the State. The plant, owned by Carolmet Inc., a subsidiary of Métallurgie Hoboken-Overpelt SA of Belgium, purchased plant feed from La Générale des Carrières et des Mines (GECAMINES), also of Belgium. Powder produced by the plant, the only extra-fine powder production facility in the United States, was used to manufacture tungsten carbide. In 1984, Carolmet began production of cobalt nitrate and cobalt chloride. Annual capacity is 330,000 pounds for each product.

**Copper and Copper Alloys.**—Scrap copper was converted to powder form by SCM Co., Glidden Metals Div., at a facility in Durham. The copper powder is used by the bearing and friction products industries.

In June, ground was broken for a $40 million narrow strip plant in Shelby. The Chase Brass & Copper Co. facility is designed to produce 50 million pounds of strip upon completion in 1985. The plant is designed to use smaller equipment than traditional brass mills and will be constructed at a significant cost savings over a full-size mill.

**Gold.**—Although there was no gold production during the year, several companies continued active exploration programs in the western part of the State. Texasgulf Minerals and Metals Corp. renewed drilling activity in the Kings Mountain area. The company leased a 450-acre tract that includes the old Kings Mountain gold mine.

Gold Fields Mining Corp. of Lakewood, CO, investigated property in the Gold Hill area in Rowan County. The company's Southeastern Div. was based in Charlotte.

Geologists from several other major mining companies were active in the Cabarrus-Rowan Counties area, which once contained several dozen mines.

**Lithium.**—Lithcoa, using molten salt electrolysis, produced lithium metal ingots, rod, wire, shot, and dispersions. The plant is located at Cherryville in the southwestern part of the State.

**Steel.**—Florida Steel Co. operated a minimill in Charlotte with two electric furnaces and two 2-stand continuous casters. In midyear, the Charlotte facility was operating on a 15-turn schedule.[13]

**Titanium and Superalloys.**—Teledyne Allvac operated a superalloy plant at Monroe. In March, an 11-million-pound-capacity, $1 million peeler was installed. During the year, an increase in production of commercial jet engines and a steady demand for military jet engines and related spare parts increased company orders by approximately 20%.[14]

The Teledyne facility produced both titanium and nickel superalloys. The aerospace and chemical process industries are the principal markets for the titanium alloys, while the nickel-based alloys find application in parts manufacture for gas turbine and jet engines, chemical processing plants, and components for sour gas deep-drilling rigs.

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] Geologist, North Carolina Geological Survey Section, Raleigh, NC.

[3] Winston-Salem Journal. Mining Mess. July 29, 1984.

[4] Laurinburg Exchange. Materials Research at NCSU Provides Basis for Innovation. Aug. 8, 1984.

[5] Raleigh News & Observer. Holders of Mineral Rights in Wilderness May Prospect, But Chances Called Slim. Aug. 26, 1984.

[6] Ceramic Industries. Duramic Expands NC Facilities. Feb. 1984, p. 10.

[7] Raleigh News & Observer. Prosperity Follows Carbon Brush Company to NC. Sept. 2, 1984.

[8] Lee Creek News. Results Take Many Years of Testing. Jan.-Feb. 1985, p. 4.

[9] Asheville Citizen. This Rocky Business Is Solid. Mar. 20, 1984.

[10] Lee Creek News. Where's the Sulfur? Sept. 1984, p. 2.

[11] American Metal Market. ALCOA Cutting Output at Two Primary Smelters. Sept. 7, 1984.

[12] ———. ALCOA Not Up for '84 Despite 4th Quarter Loss. Jan. 23, 1985.

[13] ———. Summer Slack Restricts Output. Feb. 27, 1984.

[14] ———. Falling Inventories, Surge in Jet Engines Sparking Market for Superalloys. Aug. 9, 1984.

## Table 9.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum, smelter: | | | |
| Aluminum Co. of America | 1501 Alcoa Bldg.<br>Pittsburgh, PA 15219 | Plant | Stanly. |
| Clays: | | | |
| Pine Hall Brick & Pipe Co | Box 11044<br>Winston-Salem, NC 27105 | Open pit mines and plant. | Rockingham and Stokes. |
| Sanford Brick Corp | Drawer 458<br>Sanford, NC 27330 | do | Lee and Stanly. |
| Solite Corp | Box 27211<br>Richmond, VA 23261 | do | Rockingham and Stanly. |
| Feldspar: | | | |
| The Feldspar Corp.[1] | Box 99<br>Spruce Pine, NC 28777 | Open pit mines and plants. | Mitchell. |
| Indusmin Inc | Box 309<br>Spruce Pine, NC 28777 | do | Do. |
| International Minerals & Chemical Corp.[1] | 23157 Sanders Rd.<br>Northbrook, IL 60062 | do | Do. |
| Gypsum: | | | |
| National Gypsum Co | Box 1379<br>Wilmington, NC 28402 | Plant | New Hanover. |
| Lithium: | | | |
| Foote Mineral Co.[2] | Box 792<br>Kings Mountain, NC 28086 | Open pit mine and plant. | Cleveland. |
| Lithium Corp. of America Inc.[2] | 449 North Cox Rd.<br>Gastonia, NC 28052 | do | Gaston. |
| Mica: | | | |
| Deneen Mica Co | Box 28<br>Micaville, NC 28755 | Open pit mines | Yancey. |
| Harris Mining Co.[3] | Box 628<br>Spruce Pine, NC 28777 | do | Avery. |
| Kings Mountain Mica Co. Inc.[2] | Box 709<br>Kings Mountain, NC 28086 | do | Cleveland. |
| Olivine: | | | |
| International Minerals & Chemical Corp. | Box 672<br>Spruce Pine, NC 28777 | do | Jackson and Yancey. |
| Perlite (expanded): | | | |
| Carolina Perlite Co. Inc | Box 741<br>Hillside, NJ 07205 | Plant | Rowan. |
| Phosphate rock: | | | |
| Texasgulf Inc.[4] | Box 48<br>Aurora, NC 27806 | Open pit mine and plant. | Beaufort. |
| Pyrophyllite: | | | |
| Glendon Pyrophyllite Inc | Box 306<br>Carthage, NC 28327 | Open pit mines and plant. | Alamance and Moore. |
| Piedmont Minerals Co.[5] | Box 566<br>Hillsborough, NC 27278 | Open pit mine and plant. | Orange. |
| Standard Minerals Co. Inc | Box 278<br>Robbins, NC 27325 | do | Moore. |
| Sand and gravel (construction): | | | |
| Ashland Oil Co; APAC-Carolina Inc. | Box 399<br>Kingston, NC 28501 | Open pit mines and plants. | Various. |
| Becker Sand & Gravel Co | Box 848<br>Cheraw, SC 29520 | Pits | Cumberland and Harnett. |
| B. V. Hedrick Gravel and Sand Co.[1] | Box 425<br>Swannanoa, NC 28778 | do | Anson, Buncombe, McDowell. |
| Stone: | | | |
| Martin Marietta Corp | Box 30013<br>Raleigh, NC 27622 | do | Various. |
| Nello L. Teer Co | Box 1131<br>Durham, NC 27702 | do | Do. |
| Vulcan Materials Co., Mideast Div. | Box 4195<br>Winston-Salem, NC 27105 | do | Do. |
| Talc: | | | |
| Warner Corp | Box 459<br>Murphy, NC 28906 | Underground mine | Cherokee. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co | 62 Whittemore Ave.<br>Cambridge, MA 02140 | Plant | Guilford. |

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[1] Also mica.
[2] Also feldspar.
[3] Also clays.
[4] Also byproduct gypsum.
[5] Also sericite.

# The Mineral Industry of North Dakota

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the North Dakota Geological Survey for collecting information on all nonfuel minerals.**

**By James H. Aase[1] and David W. Brekke[2]**

The value of nonfuel mineral production in North Dakota during 1984 was $21.8 million, a 14% decrease from the record high set in 1983, but 14% above the 10-year average. The decrease was attributed principally to a lower unit price for construction sand and gravel. Construction sand and gravel was the State's leading nonfuel mineral commodity in value, constituting 52% of the total output value in 1984. Other nonfuel mineral commodities produced, in descending order of production value, included lime, salt, clays, and peat, all registering gains in either quantity or value over 1983 figures.

North Dakota, in 1984, was 48th among all the States for nonfuel mineral production value, accounting for less than 1% of the U.S. total. Nationally, the quantity of salt produced in the State during 1984 was ranked 12th among 16 producing States; peat, 22d of 22; lime, 30th of 38; construction sand and gravel, 37th of 50; and clays, 41st of 44.

**Table 1.—Nonfuel mineral production in North Dakota[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Gem stones | NA | $2 | NA | $2 |
| Lime thousand short tons | 57 | 6,798 | 60 | 5,912 |
| Sand and gravel (construction) do | [e]3,800 | [e]15,000 | 6,426 | 11,351 |
| Combined value of clays, peat, and salt | XX | 3,570 | XX | 4,529 |
| Total | XX | 25,370 | XX | 21,794 |

[e] Estimated. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in North Dakota, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Barnes | $78 | (2) | |
| Bottineau | W | W | Peat. |
| Bowman | W | W | Salt. |
| Burke | W | (2) | |
| Burleigh | 525 | (2) | |
| Cass | W | (2) | |
| Dickey | 41 | (2) | |
| Divide | 42 | (2) | |
| Eddy | W | (2) | |
| Kidder | 36 | (2) | |
| McHenry | W | (2) | |
| McKenzie | 350 | (2) | |
| McLean | 218 | (2) | |
| Morton | W | W | Clays. |
| Mountrail | 300 | (2) | |
| Pembina | W | W | Lime. |
| Pierce | W | (2) | |
| Richland | W | W | Lime. |
| Rolette | 67 | (2) | |
| Stark | W | (2) | |
| Stutsman | 548 | (2) | |
| Towner | W | (2) | |
| Traill | W | W | Lime. |
| Walsh | 114 | (2) | |
| Ward | W | (2) | |
| Wells | W | (2) | |
| Williams | W | W | Salt. |
| Undistributed[3] | 10,658 | $10,370 | |
| Sand and gravel (construction) | XX | [e]15,000 | |
| Total | 12,977 | 25,370 | |

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data were not available by county. Total State values are shown separately under "Sand and gravel (construction)."

[3] Includes gem stones and some sand and gravel (construction, 1982) that cannot be assigned to specific counties and values indicated by symbol W.

## Table 3.—Indicators of North Dakota business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 672 | 681 | 686 |
| Total civilian labor force | do | 316.0 | 319.0 | 327.0 |
| Unemployment | do | 18.0 | 18.0 | 17.0 |
| Employment (nonagricultural): | | | | |
| Mining total | do | 9.4 | 7.0 | 7.4 |
| Nonmetallic minerals except fuels[1] | do | .3 | .4 | .4 |
| Coal mining | do | 1.2 | 1.2 | 1.3 |
| Oil and gas extraction | do | 7.9 | 5.4 | 5.7 |
| Manufacturing total | do | 14.9 | 14.8 | 15.5 |
| Stone, clay, and glass products | do | .8 | .8 | .8 |
| Chemicals and allied products[2] | do | .1 | .1 | NA |
| Petroleum and coal products[2] | do | .4 | .4 | NA |
| Construction | do | 15.7 | 17.5 | 14.1 |
| Transportation and public utilities | do | 16.8 | 16.1 | 16.4 |
| Wholesale and retail trade | do | 66.6 | 66.1 | 67.7 |
| Finance, insurance, real estate | do | 11.8 | 12.0 | 12.2 |
| Services | do | 54.2 | 56.0 | 57.5 |
| Government and government enterprises | do | 60.3 | 61.3 | 61.9 |
| Total | do | 249.7 | [3]250.6 | 252.7 |
| Personal income: | | | | |
| Total | millions | $7,394 | $7,944 | $8,479 |
| Per capita | | $11,008 | $11,667 | $12,352 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 37.6 | 38.0 | 38.4 |
| Total average hourly earnings, production workers | | $7.50 | $7.73 | $7.86 |

See footnotes at end of table.

## Table 3.—Indicators of North Dakota business activity —Continued

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Earnings by industry: | | | | |
| Farm income | millions | $517 | $769 | $838 |
| Nonfarm | do. | $4,583 | $4,829 | $5,065 |
| Mining total | do. | $331 | $225 | $257 |
| Nonmetallic minerals except fuels | do. | $7 | $8 | $9 |
| Coal mining | do. | $46 | $50 | $56 |
| Oil and gas extraction | do. | $279 | $167 | $191 |
| Manufacturing total | do. | $300 | $313 | $343 |
| Primary metal industries | do. | (4) | (4) | (4) |
| Stone, clay, and glass products | do. | $17 | $18 | $18 |
| Chemicals and allied products | do. | $3 | $3 | $3 |
| Petroleum and coal products | do. | $16 | $16 | $18 |
| Construction | do. | $415 | $517 | $422 |
| Transportation and public utilities | do. | $474 | $506 | $541 |
| Wholesale and retail trade | do. | $964 | $981 | $1,041 |
| Finance, insurance, real estate | do. | $223 | $245 | $266 |
| Services | do. | $892 | $997 | $1,094 |
| Government and government enterprises | do. | $964 | $1,024 | $1,000 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 2,805 | 4,392 | 3,046 |
| Value of nonresidential construction | millions | $95.7 | $102.4 | $99.1 |
| Value of State road contract awards | do. | $78.7 | $102.8 | $119.6 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 272 | 323 | 352 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $13.0 | $25.4 | $21.8 |
| Value per capita | | $19 | $37 | $32 |

[p]Preliminary. [r]Revised. NA Not available.

[1] Job Service North Dakota.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data do not add to total shown because of independent rounding.

[4] Less than 1/2 unit.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

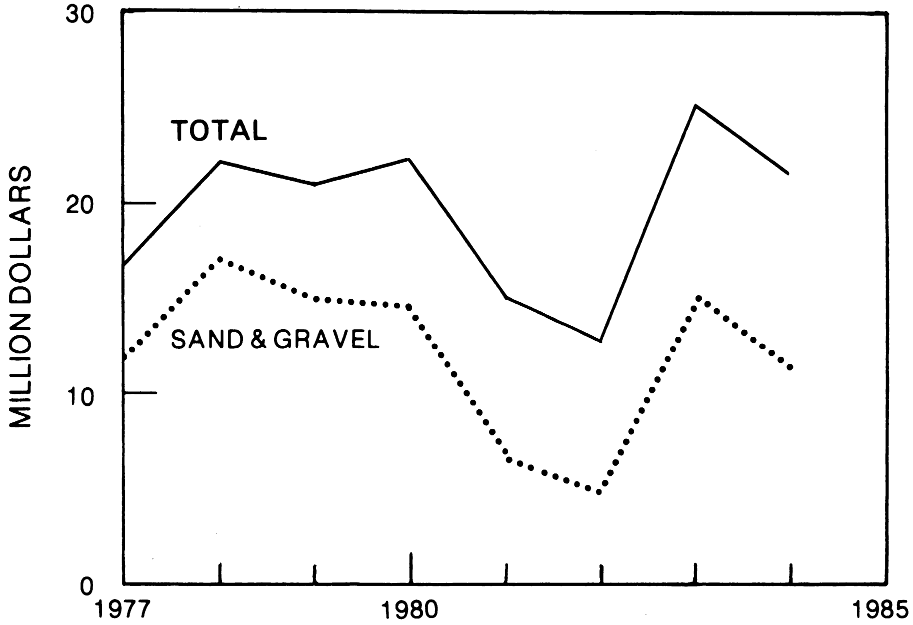

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in North Dakota.

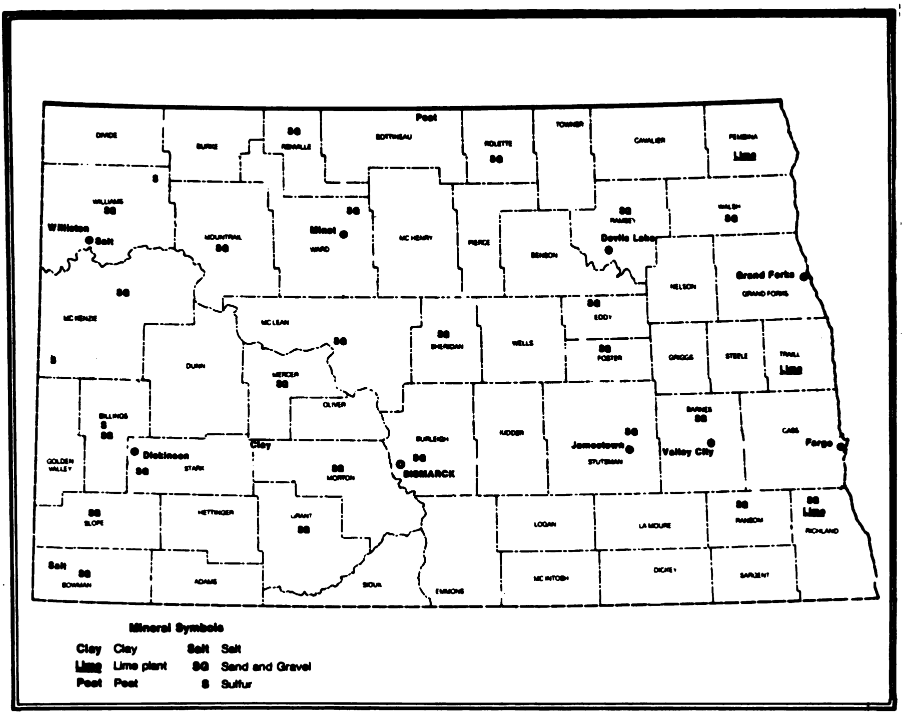

Figure 2.—Principal mineral producing localities in North Dakota.

Surface mining for minerals other than coal, as reported by the North Dakota State Soil Conservation Committee (NDSSCC), affected 462 acres, from which 3,567,697 cubic yards of mineral material was mined and 575,271 cubic yards of overburden was disturbed in 1984. NDSSCC indicated that 153 pits were operated, ranging from 0.10 to 10 acres; clay, gravel, sand, and scoria were mined from these pits.

Exploration activities, directed toward identifying occurrences of nonfuel minerals in the State, were at a standstill during 1984.

The North Dakota Geological Survey (NDGS), primarily a research organization dedicated to providing geologic input for resource development in the State, was engaged in work on more than 40 projects during 1984 designed to provide a better understanding of North Dakota's geology and mineral and water resources. Included among these projects were appraisals of the geology of various counties with five studies under way; three major mapping projects; several studies of specific geologic problems and situations that have potential to cause environmental damage; several paleontological studies of near-surface fossils with emphasis on excavation of one site and preservation of others; two paleoclimatic investigations; six detailed studies on subsurface geology, environments of deposition, depositional history, distribution, and other properties of the State's subsurface rocks; and six studies of various geologic problems with the intention of gaining a better understanding of the State's geologic history, landforms, and economic geology.

During the year, the NDGS published the results of 11 research projects, including the following: geology of Emmons and Towner Counties; ground water resources of Bottineau, Rolette, and Towner Counties; report on oil exploration and development in North Dakota during 1982 and 1983; two volumes of annual oil and gas production statistics; a new series of oil and gas field maps; reports on the environmental effect of oil and gas well drilling fluids on ground water; occurrence of mid-Paleozoic salts; and a brochure describing the geology along

North Dakota Interstate Highway 94.

North Dakota received $9.0 million as its 50% share of receipts collected on all mineral leasing rents, royalties, and bonuses collected during Federal fiscal year 1984 within the State by the Federal Government. The Federal payments were made under provisions of the Mineral Leasing Act of 1920.

Additionally, during fiscal year 1984, local governmental units within the State received $533,728 from the U.S. Department of the Interior as compensation for the loss of revenue caused by the presence of certain tax-exempt Federal lands within their boundaries. The funding, commonly referred to as "payments in lieu of taxes," was based on a formula approved by Congress in a 1976 law.

The Mining and Mineral Resources and Research Institute at the University of North Dakota, Grand Forks, was awarded a grant by the U.S. Bureau of Mines in fiscal year 1984. The grant was made to assist in the Institute's operations and research designed to encourage the training of engineers and scientists in mineral-related disciplines.

According to records maintained by the Job Service North Dakota, employment in the nonfuel minerals sector of the mining industry during 1984 averaged 420 workers, ranging from a high of 590 in August to a low of 210 during January, February, and March. These workers represented less than 1% of the total average nonagricultural work force in 1984.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Clays.**—Compared with 1983 figures, clays mined in North Dakota during 1984 increased in quantity but decreased slightly in total value. All production was obtained from two operations in Morton County.

At Hebron, Hebron Brick Co. utilized its entire output in manufacturing face brick. Near Mandan, U.S. Noonlite Ltd. manufactured lightweight aggregate from its locally mined clay. The lightweight aggregate manufactured was used principally in making building blocks and in structural concrete products.

**Gem Stones.**—No commercial gem stone mining was reported in the State during 1984. The value shown in this chapter is an estimate of the material that rockhounds, mineral collectors, and other hobbyists collected.

**Lime.**—Production of quicklime in the State during 1984 increased in quantity but decreased in value when compared with the levels attained in 1983. Two firms reported output: American Crystal Sugar Co. from plants near Drayton, Pembina County, and at Hillsboro, Traill County; and Minn-Dak Farmers Coop. at its plant near Wahpeton in Richland County. The entire output of the two firms was used in their respective sugar-refining operations at these same locations.

In 1984, approximately 114,000 short tons of lime, obtained from all domestic sources, was consumed in the State.

**Peat.**—In Bottineau County, a single operation producing reed-sedge peat accounted for the total State output in 1984. Marketed exclusively in bulk form, the output increased over that of 1983; however, total sales value decreased.

**Salt.**—Production of salt increased moderately in both quantity and value compared with the levels of 1983. The brine and evaporated salt was marketed for a variety of uses, including special salt for food processing and water softening and as a component in drilling muds. Two companies in Bowman and McKenzie Counties accounted for the brine output, and a single firm in Williams County produced evaporated material.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

In 1984, 114 companies and government agencies reported production of construction sand and gravel from 171 pits in 44 North Dakota counties. Output increased 69% over the estimated 1983 figure. The average value of the commodity was $1.77 per short ton, a 55% decrease from that marketed in 1983. Williams County, the leading county in production, followed by McKenzie, McLean, Walsh, and Stark Counties, collectively accounted for nearly one-third of the State output.

Approximately 94% of the construction sand and gravel produced during 1984 was shipped by truck, and the remainder was not transported.

### Table 4.—North Dakota: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 95 | $325 | $3.44 |
| Asphaltic concrete | 16 | 31 | 1.92 |
| Road base and coverings[1] | 1,175 | 1,594 | 1.36 |
| Fill | 67 | 145 | 2.18 |
| Snow and ice control | 6 | 21 | 3.30 |
| Railroad ballast | 195 | 489 | 2.51 |
| Other | 4,872 | 8,746 | 1.80 |
| Total or average | 6,426 | 11,351 | 1.77 |

[1] Includes road and other stabilization (cement).

### Table 5.—North Dakota: Construction sand and gravel sold or used by producers, by county

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Barnes | 2 | 37 | $78 | 6 | 127 | $222 |
| Benson | -- | -- | -- | 11 | 79 | 79 |
| Bottineau | -- | 8 | 11 | -- | -- | -- |
| Bowman | 1 | W | W | 3 | 134 | 232 |
| Burleigh | 2 | 214 | 525 | 6 | W | W |
| Dickey | -- | 30 | 41 | 7 | 80 | 140 |
| Divide | 1 | 28 | 42 | -- | -- | -- |
| Eddy | 2 | W | W | 3 | 308 | 597 |
| Grand Forks | -- | -- | -- | 3 | 57 | 88 |
| Kidder | 3 | 31 | 36 | 3 | 63 | 98 |
| Logan | -- | -- | -- | 1 | 3 | 12 |
| McIntosh | -- | -- | -- | 1 | 5 | 16 |
| McKenzie | 1 | 189 | 350 | 5 | 442 | 738 |
| McLean | 3 | 118 | 218 | 14 | 406 | 533 |
| Mercer | -- | -- | -- | 4 | 231 | 346 |
| Morton | 1 | 35 | 59 | 5 | 184 | 288 |
| Mountrail | 4 | 300 | 300 | 4 | 162 | 256 |
| Ransom | -- | -- | -- | 3 | 166 | 290 |
| Renville | -- | -- | -- | 3 | 137 | 227 |
| Richland | 1 | 40 | 60 | 4 | 243 | 605 |
| Rolette | 15 | 60 | 67 | 14 | 159 | 291 |
| Stutsman | 5 | 224 | 548 | 4 | 264 | 575 |
| Traill | 2 | W | W | 3 | 57 | 105 |
| Walsh | 3 | 71 | 114 | 7 | 359 | 682 |
| Ward | 4 | W | W | 3 | 223 | 391 |
| Williams | 1 | 29 | 94 | 15 | 540 | 906 |
| Undistributed[1] | [r]14 | 934 | 2,330 | 39 | 1,998 | 3,632 |
| Total[2] | 65 | 2,347 | 4,873 | 171 | 6,426 | 11,351 |

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Adams (1984), Billings (1984), Burke, Cass (1982), Dunn (1984), Foster (1984), Golden Valley (1984), Grant (1984), Griggs (1984), Hettinger (1984), La Moure (1984), McHenry, Oliver (1984), Pembina (1982), Pierce, Ramsey (1984), Sargent (1984), Sheridan (1984), Sioux (1984), Slope (1984), Stark, Towner, and Wells (1982) Counties, sand and gravel that cannot be assigned to specific counties (1982), and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

**Sulfur (Recovered).**—Elemental sulfur was recovered as a byproduct at the natural gas processing plants of five companies in Billings, McKenzie, and Williams Counties in western North Dakota, and at Amoco Oil Co.'s petroleum refinery in Mandan, Morton County. Shipments during 1984 totaled 112,000 metric tons, valued at $5,572,000, representing increases of 10% and 14%, respectively, over 1983 figures.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN.

[2] Geologist, North Dakota Geological Survey, Grand Forks, ND.

## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays: | | | |
| Hebron Brick Co | Hebron, ND 58638 | Pit and plant | Morton. |
| U.S. Noonlite Ltd | Box 117<br>Mandan, ND 58554 | do | Do. |
| Lime: | | | |
| American Crystal Sugar Co | 101 North 3d St.<br>Moorhead, MN 56560 | Shaft kilns at beet sugar refineries. | Pembina and Traill. |
| Minn-Dak Farmers Coop | Wahpeton, ND 58075 | do | Richland. |
| Peat: | | | |
| Peat Products Co | 821 4th St.<br>Bismarck, ND 58501 | Bog | Bottineau. |
| Salt: | | | |
| Hardy Salt Co | Drawer 449<br>St. Louis, MO 63166 | Brine well and plant | Williams. |
| Koch Exploration Co | Box 2256<br>Wichita, KS 67201 | do | Bowman. |
| Williams Exploration Co | 3025 South Parker Rd.<br>Suite 600<br>Aurora, CO 80014 | do | McKenzie. |
| Sand and gravel (construction): | | | |
| Badinger Sand & Gravel Co | Box 306<br>Dickinson, ND 58601 | Pits and plants | Bowman, Dunn, Eddy, Golden Valley, Grant, Sioux, Slope. |
| Des Lacs Sand & Gravel Co | Box 66<br>Des Lacs, ND 58733 | do | McLean, Mountrail, Rolette, Ward, Williams. |
| Earth Builders Inc | Box 838<br>Bismark, ND 58501 | do | Adams, Bowman, Ward, Williams. |
| Fisher Sand & Gravel Co | Box 1034<br>Dickinson, ND 58601 | do | Bowman, Hettinger, McKenzie, McLean, Mercer, Morton, Oliver, Stark. |
| Holen Construction Co | Box 126<br>McClusky, ND 58463 | do | Billings, Kidder, McKenzie, Sheridan. |
| Lindteigen Construction Co. Inc | Turtle Lake, ND 58575 | do | Foster, Griggs, McLean, Morton. |
| Northern Improvement Co | Box 1254<br>Bismarck, ND 58501 | do | Burleigh and Morton. |
| Schriock Construction Inc | 3009 South Broadway<br>Minot, ND 58701 | do | Golden Valley, Kidder, McKenzie, Mercer, Mountrail, Renville. |
| Sulfur (recovered): | | | |
| Aminoil USA Inc | Box 94193<br>Houston, TX 77018 | Plant | Williams. |
| Koch Hydrocarbon Co | Box 2256<br>Wichita, KS 67201 | do | McKenzie. |
| Warren Petroleum Corp., a division of Gulf Oil Corp. | Box 1589<br>Tulsa, OK 74101 | do | Billings. |

# The Mineral Industry of Ohio

## By William A. Bonin[1]

Ohio's nonfuel mineral production in 1984 was valued at $552.9 million. The 15.4% increase over 1983 ranked the State 13th nationally. Principal mineral commodities produced included crushed stone, salt, construction sand and gravel, lime, cement, and industrial sand. Clays, dimension stone, gypsum, and peat were also mined. Natural and manufactured abrasives, including artificial industrial diamonds, were produced. Cultured quartz crystals were grown, and synthetic graphite was manufactured.

Iron ore concentrates, alumina, beryllia, and titanium raw materials were shipped into the State for the production of metals; titanium dioxide and synthetic iron oxide pigments were manufactured. Iron and steel slag was processed for use as construction aggregate and fill, and elemental sulfur was recovered as a nondiscretionary byproduct of petroleum refineries and coke ovens.

Fluorspar, perlite, talc, and vermiculite were received and processed into higher value-added products. Zinc oxide was manufactured from shipments of zinc concentrates, and refined zinc and zirconium materials were manufactured. Also, various strontium compounds and barium chemicals were produced from out-of-State shipments.

**Table 1.—Nonfuel mineral production in Ohio[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Cement: | | | | |
| Masonry thousand short tons | 97 | $7,454 | 101 | $8,092 |
| Portland do | 1,575 | 71,599 | 1,525 | 69,810 |
| Clays do | 1,716 | 8,061 | 1,960 | 10,473 |
| Lime do | 1,906 | 84,928 | 1,859 | 87,951 |
| Peat do | W | W | 13 | 345 |
| Salt do | 2,565 | 85,988 | W | W |
| Sand and gravel: | | | | |
| Construction do | $^{e}$27,200 | $^{e}$84,600 | 31,748 | 104,709 |
| Industrial do | 1,226 | 17,848 | 1,506 | 20,829 |
| Stone: | | | | |
| Crushed do | 32,937 | 114,059 | $^{e}$38,500 | $^{e}$139,000 |
| Dimension do | 49 | 2,923 | $^{e}$37 | $^{e}$3,454 |
| Combined value of abrasives, gem stones, gypsum, and values indicated by symbol W | XX | 1,684 | XX | 108,240 |
| Total | XX | 479,144 | XX | 552,903 |

$^{e}$Estimated. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Ohio, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adams | (2) | W | Stone (crushed). |
| Allen | (2) | $3,727 | Do. |
| Ashland | W | W | Clays. |
| Ashtabula | W | 2,186 | Lime. |
| Athens | W | W | Stone (crushed). |
| Auglaize | W | W | Stone (crushed), clays. |
| Belmont | W | W | Stone (crushed). |
| Brown | (2) | 14 | Do. |
| Butler | $4,458 | (3) | |
| Carroll | 129 | 726 | Stone (crushed), stone (dimension). |
| Champaign | 572 | (3) | |
| Clark | 2,198 | W | Stone (crushed). |
| Clermont | 144 | (3) | |
| Clinton | (2) | W | Stone (crushed). |
| Columbiana | W | W | Clays, stone (crushed). |
| Coshocton | W | W | Stone (dimension), clays. |
| Crawford | (2) | W | Stone (crushed). |
| Cuyahoga | 25,995 | W | Salt, lime, clays, peat. |
| Darke | 1,765 | W | Stone (crushed). |
| Delaware | (2) | W | Do. |
| Erie | W | W | Lime, stone (crushed), sand and gravel (industrial). |
| Fairfield | W | (3) | |
| Fayette | (2) | 1,160 | Stone (crushed). |
| Franklin | 6,519 | W | Stone (crushed), clays, industrial diamonds. |
| Gallia | 197 | 30 | Sand and gravel (industrial). |
| Geauga | 7,108 | W | Sand and gravel (industrial), stone (crushed). |
| Greene | W | W | Cement, stone (crushed), clays. |
| Hamilton | 8,078 | (3) | |
| Hancock | (2) | 1,644 | Stone (crushed). |
| Hardin | (2) | W | Do. |
| Harrison | W | W | Clays. |
| Henry | W | W | Do. |
| Highland | (2) | W | Stone (crushed). |
| Hocking | 520 | 93 | Clays. |
| Holmes | W | W | Stone (crushed), clays, stone (dimension). |
| Huron | W | W | Stone (crushed). |
| Jackson | W | W | Clays, stone (crushed). |
| Knox | W | W | Sand and gravel (industrial), stone (dimension). |
| Lake | 31,110 | W | Lime, salt. |
| Lawrence | W | W | Cement, stone (crushed), clays. |
| Licking | W | W | Clays. |
| Logan | W | W | Stone (crushed), peat. |
| Lorain | W | W | Stone (dimension), stone (crushed), natural abrasives. |
| Lucas | W | W | Stone (crushed), cement, clays. |
| Mahoning | W | W | Stone (crushed), clays, peat. |
| Marion | 92 | 1,758 | Stone (crushed), clays. |
| Medina | W | W | Clays. |
| Meigs | 7,482 | (3) | |
| Mercer | (2) | W | Stone (crushed). |
| Miami | 1,052 | 4,151 | Do. |
| Monroe | (2) | W | Do. |
| Montgomery | 2,071 | 1,439 | Do. |
| Morgan | W | (3) | |
| Morrow | 191 | (3) | |
| Muskingum | W | W | Cement, stone (crushed), clays. |
| Noble | (2) | 1,035 | Stone (crushed). |
| Ottawa | W | W | Stone (crushed), lime, gypsum. |
| Paulding | W | W | Cement, stone (crushed), clays. |
| Perry | W | W | Sand and gravel (industrial), stone (crushed), clays. |
| Pickaway | W | (3) | |
| Pike | W | W | Stone (crushed). |
| Portage | 7,615 | (3) | |
| Preble | W | W | Stone (crushed). |
| Putnam | W | W | Stone (crushed), clays. |
| Richland | W | W | Clays. |
| Ross | W | W | Sand and gravel (industrial). |
| Sandusky | W | W | Lime, stone (crushed). |
| Scioto | W | W | Stone (dimension). |
| Seneca | W | 7,344 | Stone (crushed), lime, stone (dimension). |
| Shelby | 552 | 810 | Stone (crushed). |
| Stark | 11,103 | W | Cement, stone (crushed), clays. |
| Summit | W | W | Salt. |
| Trumbull | W | W | Stone (crushed). |
| Tuscarawas | W | W | Clays, sand and gravel (industrial), stone (dimension). |
| Union | (2) | W | Stone (crushed). |
| Van Wert | (2) | 1,352 | Do. |
| Warren | 2,783 | W | Do. |
| Washington | 712 | 18 | Do. |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Ohio, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Wayne | W | W | Salt, stone (crushed). |
| Williams | W | W | Peat. |
| Wood | ([2]) | $3,147 | Stone (crushed). |
| Wyandot | $4,396 | W | Stone (crushed), lime, peat, clays. |
| Undistributed[4] | [r]214,313 | 363,909 | |
| Sand and gravel (construction) | XX | [e]84,600 | |
| Stone: | | | |
| Crushed | [e]105,200 | XX | |
| Dimension | [r] [e]2,765 | XX | |
| Total | [r]449,120 | [5]479,144 | |

[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Ohio business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 10,772 | 10,736 | 10,752 |
| Total civilian labor force | do | 5,114 | 5,100 | 5,099 |
| Unemployment | do | 640 | 621 | 481 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 30.3 | 26.6 | 27.6 |
| Metal mining[2] | do | ([3]) | ([3]) | NA |
| Nonmetallic minerals except fuels[2] | do | 4.3 | 4.2 | NA |
| Coal mining | do | 13.3 | 11.1 | 11.7 |
| Oil and gas extraction | do | NA | 11.2 | 11.6 |
| Manufacturing total | do | 1,099.9 | 1,066.0 | 1,125.1 |
| Primary metal industries | do | 112.7 | 104.1 | 108.3 |
| Stone, clay, and glass products | do | 54.2 | 52.1 | 52.5 |
| Chemicals and allied products | do | 65.5 | 63.4 | 62.8 |
| Petroleum and coal products[2] | do | 9.2 | 9.0 | NA |
| Construction | do | 134.6 | 130.8 | 142.9 |
| Transportation and public utilities | do | 206.8 | 198.5 | 205.7 |
| Wholesale and retail trade | do | 929.3 | 933.5 | 976.8 |
| Finance, insurance, real estate | do | 206.4 | 207.0 | 211.5 |
| Services | do | 857.3 | 873.3 | 903.8 |
| Government and government enterprises | do | 659.6 | 656.1 | 654.5 |
| Total[4] | do | 4,124.3 | 4,091.7 | 4,248.0 |
| Personal income: | | | | |
| Total | millions | $114,881 | $1200,854 | $132,842 |
| Per capita | | $10,664 | $11,257 | $12,355 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 40.1 | 41.4 | 42.3 |
| Mining | | 43.1 | 43.1 | 43.9 |
| Total average hourly earnings, production workers | | $10.07 | $10.56 | $10.96 |
| Mining | | $10.37 | $10.61 | $11.26 |
| Earnings by industry: | | | | |
| Farm income | millions | $704 | $325 | $1,234 |
| Nonfarm | do | $81,132 | $85,533 | $94,175 |
| Mining total | do | $991 | $852 | $951 |
| Metal mining | do | $-13 | $-5 | $-6 |
| Nonmetallic minerals except fuels | do | $93 | $90 | $104 |
| Coal mining | do | $460 | $415 | $468 |
| Oil and gas extraction | do | $451 | $351 | $385 |
| Manufacturing total | do | $28,875 | $30,022 | $33,513 |
| Primary metal industries | do | $3,717 | $3,584 | $4,005 |
| Stone, clay, and glass products | do | $1,375 | $1,403 | $1,500 |
| Chemicals and allied products | do | $1,924 | $2,008 | $2,116 |
| Petroleum and coal products | do | $393 | $411 | $454 |
| Construction | do | $3,540 | $3,634 | $4,146 |
| Transportation and public utilities | do | $5,777 | $5,927 | $6,356 |
| Wholesale and retail trade | do | $12,692 | $13,236 | $14,546 |
| Finance, insurance, real estate | do | $3,724 | $4,223 | $4,589 |
| Services | do | $14,420 | $15,864 | $17,609 |
| Government and government enterprises | do | $10,908 | $11,552 | $12,216 |

See footnotes at end of table.

**Table 3.—Indicators of Ohio business activity —Continued**

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 16,640 | 26,741 | 28,946 |
| Value of nonresidential construction millions | $1,534.2 | $2,066.5 | $2,103.9 |
| Value of State road contract awards do. | $345.0 | $548.0 | $590.3 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 2,139 | 2,427 | 2,736 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $449.1 | $479.1 | $552.9 |
| Value per capita | $42 | $45 | $51 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U. S. Department of Commerce.

[3] Less than 50 employees.

[4] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

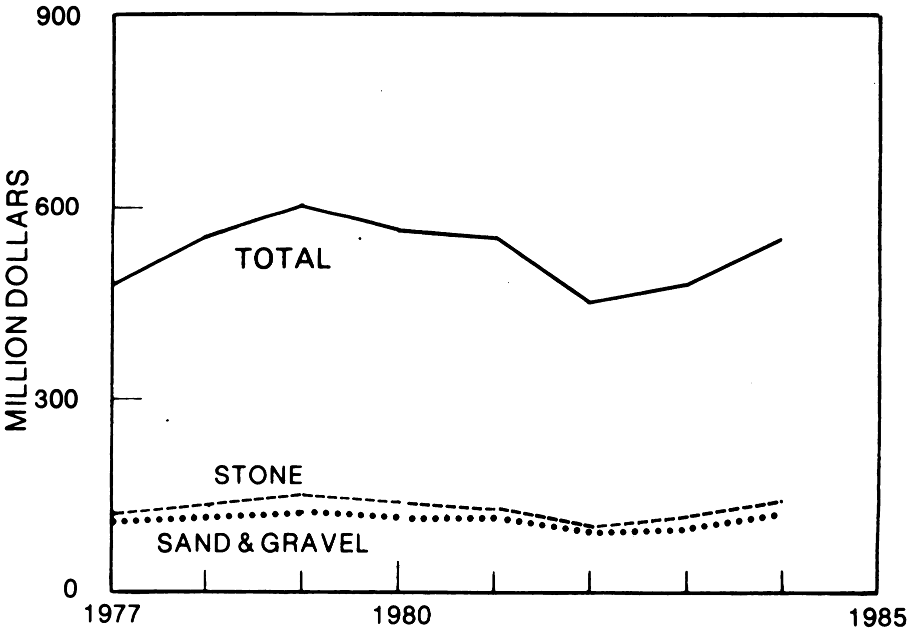

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Ohio.

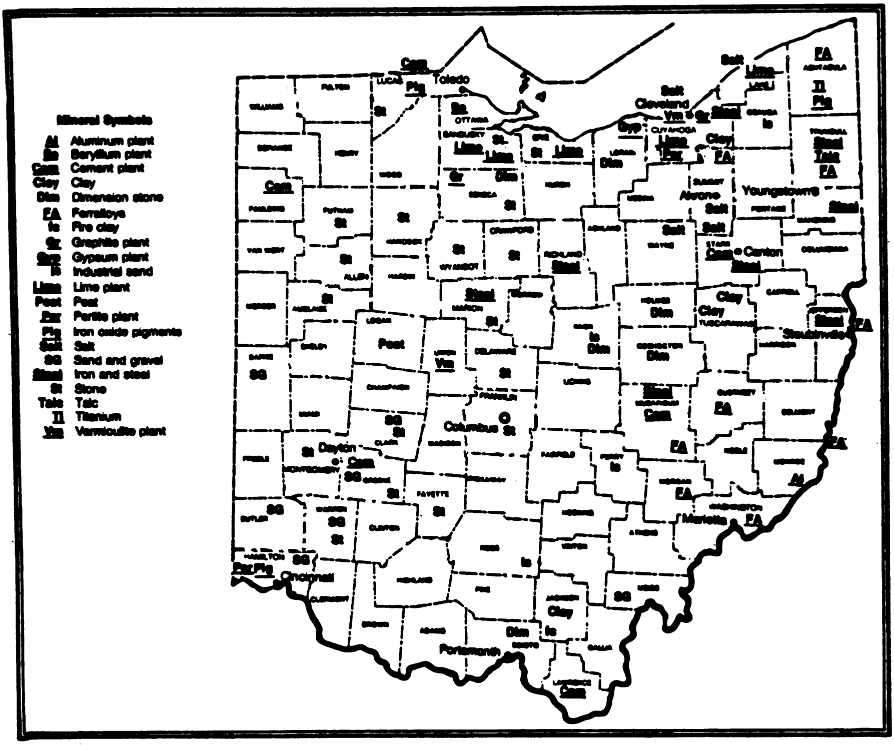

Figure 2.—Principal mineral producing localities in Ohio.

**Exploration Activities.**—Despite modest gains, 1984 was a slow year for the mineral industry in Ohio. The value of nonfuel mineral production increased 15.4% to $552.9 million; while, according to the Ohio Division of Geological Survey (DGS), coal shipments increased 15% to $1.3 billion and the combined value of crude oil and gas production increased 11.7% to $1.0 billion. No major exploration programs were conducted during the year.

An important exploration tool became available in 1984 with the release of an aeromagnetic map of the State. The map, produced by the DGS and the U.S. Geological Survey (USGS), showed a 30-mile-wide zone of relatively intense circular magnetic anomalies and steep magnetic gradients. Intrusions and faulting in the Precambrian basement along a north-south zone from western Lake Erie to the Ohio River were suggested. Late in the year, the DGS drilling capacity was increased from 2,200 feet to 3,000, and the rig was moved to northwestern Ohio to drill three holes sited on the basis of some of these impressive magnetic anomalies. The drilling was intended to provide unique continuous core information for the lower Paleozoic and Upper Cambrian rocks and zones of potential sulfide mineralization. Also, financial support from a university research group allowed for additional coring in the Precambrian to obtain rock samples for age dating to provide important new geologic insights into this essentially unstudied sequence in Ohio.

The DGS also completed its ongoing deep-coal exploration program in Guernsey County. The 15 holes drilled produced over 9,000 feet of core that revealed the possibility of substantial new resources. Columbiana and Mahoning Counties in northeastern Ohio were scheduled next in this drilling program.

The possibility of diamond-bearing kimberlites in the Upper Midwest, including Ohio, sparked some exploration interest. However, there was little public information on these activities. At least one company was researching the occurrence of diamonds in the region.

**Legislation and Government Programs.**—From a legislative standpoint, 1984 was a quiet year for the State's minerals industry. However, the Ohio Supreme Court had a far greater effect. The Court, in a historic ruling, handed down a decision related to ground water. It ruled that the English rule of "absolute ownership" doctrine would no longer apply in Ohio, and that the "reasonable use" doctrine would now apply in the reselution of ground water conflicts. With this decision, the extractive industries that dewater or use ground water for processing were placed in the position of not having guidelines to define "reasonable use."

The DGS, founded in 1837 and legislatively authorized since 1869, conducted investigations of the geology and mineral resources of the State of Ohio. During 1984, the DGS responded to over 64,000 public inquiries and distributed nearly 300,000 maps, publications, and related geologic records. The DGS duties and responsibilities were carried out by a staff of 58 employees including 34 professional geologists and chemists.

DGS experienced considerable expansion during the year in order to implement the statewide geologic mapping program. This program would result in the eventual completion of bedrock, glacial, and various derivative maps of each county in the State. Mineral resources investigations and stratigraphic studies were greatly facilitated in 1984 by DGS acquisition of a core-drilling rig. Core drilling was largely concentrated in the coal-bearing Pennsylvanian rocks of eastern Ohio. Investigation of lower Paleozoic, high-carbonate limestone and zones of potential sulfide mineralization were also conducted in western Ohio. A report on the Ordovician Trenton Limestone of northwestern Ohio, a major turn-of-the-century reservoir that has received much interest in recent years, was published by DGS. Also, the USGS published aeromagnetic and gravity maps of the State. These maps were compiled as a cooperative project with DGS. DGS was also heavily involved with detailed analysis of Ohio coals. In this cooperative program with the USGS, representative samples were collected for proximate, ultimate, and major-, minor-, and trace-element analyses in both whole coal and ash. Another major DGS project in 1984 was the investigation of chemical and physical properties of carbonate aggregates.

The U.S. Environmental Protection Agency awarded the Limestone Multistage Burner (LIMB) project to a joint venture involving Babcock & Wilcox Co., Ohio Edison, and the Ohio Coal Development Board. The LIMB project, totaling more than $18 million in Federal, State, and private sector financing, would be at the Ohio Edison Edgewater plant in Lorain County. The demonstration project would consist of a small, 100-megawatt unit that would inject pulverized limestone into the boiler to neutralize the sulfur dioxide released from the burning coal.

The U.S. Bureau of Mines made a grant to Ohio State University, Mining and Mineral Resources and Research Institute, at Columbus, which provided a focal point for mineral engineering research in support of the minerals industry. Ohio State University was also an affiliate of the University of Missouri at Rolla, one of the five generic mineral technology centers in the United States with expertise in the area of pyrometallurgy.

During 1984, U.S. Forest Service planners were heavily involved in the different phases of the land management plan for the Wayne National Forest. Land management goals were developed that addressed issues and concerns identified by the public and the forest planning team. Forest conditions were described in terms of vegetation, wildlife, recreation, minerals, and other resources. Data were collected to analyze costs and benefits of various land use alternatives. Minerals management would be particularly complex on the Wayne National Forest because 90% of the mineral rights are owned by private organizations and individuals. The draft plan for the Wayne National Forest and the accompanying environmental impact statement would be completed in 1985.

Mine reclamation projects were planned

in both the Ironton and Athens Districts by the Forest Service in cooperation with the State of Ohio. Two projects in the Ironton area would be completed in cooperation with the Ohio Department of Natural Resources, Division of Reclamation. One project would involve quenching the fires of a burning waste coal pile and the related restoration activities. The second project would involve reclamation of 73 acres of abandoned surface mined land. Initial planning was also scheduled for reclamation projects on the Glen Ebon and Rock Run sites of the Athens District.

There are 832,000 acres within the Wayne National Forest boundary, of which 177,485 acres (21%) are in National Forest ownership. During 1984, no additional land was purchased. However, there were 138 oil and gas leases with 65 more pending, over 900 estimated oil and gas wells, and an additional 141 mineral-related permits. In 1984, financial returns to counties within the Wayne National Forest totaled $192,712. Payments in lieu of taxes were $37,201. County revenue for timber sales and camping and mineral leases was $155,511.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Abrasives.**—*Manufactured.*—The manufactured abrasives industry, which had been particularly depressed since 1981, showed strong signs of recovery during the year. However, this turnaround was hampered by the modest recovery in heavy industries, the prime outlet for metallic abrasives.

Three companies produced metallic abrasives during the year. Globe Steel Abrasives Co. at Mansfield in Richland County and National Metal Abrasive Co. at Wadsworth in Medina County produced steel shot and grit. Steel Abrasives Inc., sister company of Globe Steel Abrasives, at Hamilton in Butler County, produced both chilled and annealed iron shot and grit. Ohio, along with Indiana, Michigan, Pennsylvania, and Virginia, supplied 100% of the metallic abrasives sold or used in the Nation. The quantity and value of sales in Ohio increased by 22% and 27%, respectively, over 1983 levels. Only two companies, Steel Abrasives in Ohio and one company in Indiana, produced chilled and annealed iron shot and grit in the United States. Shipments increased 9% in both quantity and value.

The General Electric Co. (GE), Specialty Materials Department at Worthington in Franklin County, manufactured industrial abrasives and diamonds. GE is one of five companies that produced artificial industrial diamonds in the United States. The United States remained the largest consumer of natural industrial diamonds, but was totally dependent on foreign sources.

*Natural.*—Cleveland Quarries Co. produced grindstones and deburring media as a coproduct of its dimension sandstone quarrying operations in the South Amherst area of Lorain County. The company stated that it is the largest producer and fabricator of sandstone in the world; it is the sole reporting producer of natural grindstone in the Nation.

**Cement.**—Although U.S. cement production and consumption increased to near record high levels, reflecting a growth of building and construction activity and continuing improvement in the U.S. economy, the quantity and value of Ohio shipments decreased 8.7% and 1.5%, respectively, from 1983 levels. Also, percent of capacity utilization for Ohio's portland cement production was only 58% compared with 72% for the Nation. Contributing to this underutilization of capacity in Ohio was the strike against General Portland Inc.'s plant at Paulding, beginning in July and ending in mid-November, which totally shut down production. The company's other operations—two in Texas, and one plant each in Alabama, Florida, Kansas, and Pennsylvania—continued to operate with management and contract personnel during the labor dispute.

Five companies operated six cement plants in Ohio during 1984. Columbia Cement Corp. at Zanesville, General Portland at Paulding, Lone Star Marquette Co. at Superior, and Southwestern Portland Cement Co. at Fairborn produced both portland and masonry cement. Only portland cement was manufactured by SME Cement Inc. at its Middlebranch and Sylvania plants. Moore McCormack Resources Inc. operated a cement distribution terminal in Cincinnati. Late in the year, principals involved in SME Industries Inc. acquired the Zanesville cement plant and cement terminals in West Virginia and Ohio that were formerly operated by Columbia Cement. The acquired company was named

Columbia Portland Cement Corp. Also, Southwestern Portland Cement continued plans for a quarry expansion at its Fairborn plant.

Table 4.—Ohio: Masonry cement salient statistics

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 4 | 4 |
| Production | 97,707 | 103,021 |
| Shipments from mills: | | |
| Quantity | 97,475 | 101,211 |
| Value | $7,454,010 | $8,091,827 |
| Stocks at mills, Dec. 31 | 20,897 | 23,262 |

Table 5.—Ohio: Portland cement salient statistics

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 6 | 6 |
| Production | 1,629,517 | 1,508,037 |
| Shipments from mills: | | |
| Quantity | 1,574,762 | 1,525,326 |
| Value | $71,598,540 | $69,809,563 |
| Stocks at mills, Dec. 31 | 212,491 | 244,717 |

**Clays.**—Common clay and shale used by Ohio producers in 1984 increased 13% in tonnage and 18% in value over 1983 levels. This increase, for the second consecutive year, continued to reverse the downward trend in production that had persisted from 1978 to 1982. The increased demand for the State's clay building materials—brick, portland cement, lightweight aggregate, floor and wall tile, flue lining, vitrified sewer pipe, and other structural clay products—followed the upturn in the construction industry, the largest consumer of heavy clay products. This upturn in construction activity was due in part to the softening of interest rates and an improving business climate. The continued growth of the energy intensive clay-based industries could be slowed again by the return of higher energy costs and lower construction costs.

In 1984, the State's reported production was 1.7 million short tons, valued at $5.5 million—189,000 tons and $829,000 more than in 1983. Of these totals, 920,000 tons was used for the manufacture of building bricks valued at $3.2 million. Crescent Brick Co. Inc., based in western Virginia, purchased the mines and plants of Cedar Heights Clays Co. of Oak Hill. Cedar Heights was the State's largest producer of prepared clays in 1984.

Production of fire clay increased by 22% over that of 1983, while value increased 46%. This was the second consecutive year of significant increases in both production and value. In 1984, the State's reported production was 303,000 tons, valued at $5 million—55,000 tons and $1.6 million more than in 1983. This increase was caused largely by an improved overall economy and a modest recovery, which continued for the depressed major refractory consumers—steel mills and foundries. The end uses of fire clay, which occur as underclays below coal seams, were in the manufacture of fire brick, floor and wall tile, refractories, and foundry sand.

In a final move to divest itself of refractory holdings, Kaiser Aluminum & Chemical Corp. announced plans to sell its North American refractory operations to a company organized by management of the company's Refractories Div. and Kelso & Co., an investment banker. The Refractories Div. had manufacturing, research, and administrative facilities in Columbiana, as well as California, Indiana, Missouri, and Ontario, Canada.

**Fluorspar.**—Inverness Mining Co. dried imported acid-grade fluorspar from the Republic of South Africa at its East Liverpool drying plant on the Ohio River. Most of it was for the ceramics market. The company also operated drying plants using foreign fluorspar at the Minerva mill and at Cave-in-Rock, IL. Its mines near Cave-in-Rock remained closed, and after 2 years of maintenance pumping and ventilating, the underground equipment was removed and the mine allowed to flood.

**Graphite (Synthetic).**—Two companies manufactured graphite—the Carbon Products Div. of Union Carbide Corp. at Fosteria and Ohio Carbon Co. in Cleveland. Union Carbide's products included anodes, electrodes, unmachined shapes, motor brushes, powder, cloth, and high-modulus fibers. A new market for graphite fibers was in the cathodic protection of reinforced steel in concrete bridge decks. Ohio Carbon produced motor brushes and unmachined shapes.

Synthetic graphite scrap and powder, including electrode scrap, was in ample supply to meet demand of manufacturers in 1984. This was because the steel industry, the principal user of electrodes, grew about 10% in volume over its depressed 1983 levels. There was also a continued trend toward electric-furnace melting of steel in 1984. It grew to about 30% of all domestic steel produced. When more steel is produced in electric furnaces, more electrodes are produced to meet demand. Hence, more electrode scrap is generated.

**Gypsum.**—Ohio's gypsum industry in 1984 followed the high activity in construction and housing, as this sector was spurred on by lower interest rates and pent-up demand. Wallboard shipments set monthly records for the first 5 months of the year and then leveled off slightly through December.

Celotex Corp., a subsidiary of Jim Walter Corp., was the only producer of crude gypsum in Ohio. The company reported a substantial increase in production and value from its captive America No. 2 open pit mine on Marblehead Peninsula in Ottawa County.

National Gypsum Co. at its Lorain plant in Lorain County and United States Gypsum Co. at its Ottawa County plant at Gypsum, calcined crude gypsum shipments from out-of-State. Celotex calcined crude gypsum at its captive mine plant. These three facilities calcined 404,000 short tons of crude, valued at $9.4 million—a 39% increase in production and a 45.5% increase in value over 1983 levels.

**Iron Oxide Pigments (Synthetic).**—The Hilton-Davis Chemical Co. Div., Sterling Drug Inc., was the State's sole producer of finished pigments. The company, at its Cincinnati manufacturing and research facility, produced industrial flushed and dry colors for worldwide markets.

**Lime.**—In Ohio, following a good first two quarters in 1984, lime sales slipped badly during the last half of the year. Production decreased by 2.5% from that of 1983, while value increased 3.6%. This was the second year of increased value since the deep recession of 1982; however, the increase was relatively minor, making the 1984 sales volume 46% below the record high set in 1978.

Ohio continued to lead the Nation in lime production and ranked second in consumption. In 1984, 8 companies at 11 plants produced 1.9 million short tons of lime valued at $88 million. The Woodsville No. 1 plant of Martin Marietta Corp. in Sandusky County was the 3d leading producer of lime in the United States, and the Grand River plant of LTV Steel Co. in Lake County ranked 10th. About 52% of lime production was used in basic oxygen furnace (BOF) steelmaking. In that use category, although sales remained essentially unchanged, value increased 6.5% over that of 1983. However, lime used for electric-furnace steelmaking decreased 41% while value fell by 44.5%. As markets for lime continued to be depressed, particularly in the iron and steel industries, three Ohio plants were permanently closed—Cuyahoga Lime Co. in Cleveland, Pfizer Inc. at Gibsonburg, and Basic Inc. at Maple Grove.

**Table 6.—Ohio: Lime sold or used by producers, by use**

| Use | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity (short tons) | Value (thousands) | Quantity (short tons) | Value (thousands) |
| Steel, basic oxygen furnace | 966,898 | $43,528 | 960,929 | $46,366 |
| Refractories | 149,998 | 7,508 | W | W |
| Steel, electric | 81,235 | 4,091 | 47,886 | 2,266 |
| Water purification | 43,600 | 1,984 | W | W |
| Steel, open-hearth | 27,077 | 1,417 | W | W |
| Sewage treatment | 22,121 | 974 | 19,169 | 862 |
| Other[1] | 614,905 | 25,426 | 830,816 | 38,457 |
| Total | 1,905,834 | 84,928 | 1,858,800 | 87,951 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes acid water neutralization, agriculture, calcium carbide, finishing lime, glass, ladle desulfurization (1984), magnesia from seawater or brine, mason's lime (1984), magnesium, other chemical and industrial uses, paper and pulp, road stabilization, sand-lime brick (1984), sugar refining, sulfur removal from stack gases (1984), and uses indicated by symbol W.

**Peat.**—A total of 13,000 short tons of peat, valued at $345,000, was sold from six active operations in seven Ohio counties during 1984. About 75% of sales was packaged. Reed-sedge, sphagnum moss, and humus produced at five of the operations were used for mulch, soil conditioning, and worm culture. Kalo Inc. at its humus plant at Crawford in Wyandot County processed a small volume of peat and marketed the high-value product for legume innoculation. Kalo was formerly Agricultural Laboratories Inc.

**Perlite (Expanded).**—Colotex, Cincinnati, and Cleveland Builders Supply Co., Cleveland, discontinued operations in 1984. However, for the total U.S. expanded perlite industry, 1984 was better than 1983 owing to strengthening in the construction and industrial markets. Construction and industry-related uses of expanded perlite include roof insulation board, acoustic ceiling tile, pipe insulation, plaster and concrete aggregate, paint texturizer, loose-fill insulation, masonry and cavity fill insulation, and refractories. These account for about 75% of domestic consumption. Sales increased 5% in 1984 to reverse a 6-year decline in the U.S. expanded perlite industry.

**Quartz Crystal (Cultured).**—Sawyer Research Products Inc., the leading grower of cultured quartz in the United States, was one of seven domestic producers. At the Eastlake facility in Lake County, the independent grower produced quartz bars for domestic and foreign consumers in the crystal-device-fabrication industry. The company operated at near full capacity for most of the year because of the strong worldwide demand in piezoelectric applications of cultured quartz crystals, which is the primary quartz material used in electronics. The piezoelectric effect is achieved when a suitable electrical signal is applied to a quartz wafer or blank with appropriate electrodes, and the wafer then vibrates mechanically throughout the bulk of the material at a characteristic natural resonance frequency. The quartz resonators are uniquely suitable for military-aerospace and commercial bandpass filter applications that require very high selectivity or in oscillator applications that require very high stability. Usage in new products—such as videocassette recorders, personal computers, and cordless telephones—and in more established products—such as watches, clocks, radios, electronic games, televisions, and microprocessors in industrial, automotive, and consumer products—accounted for much of the demand.

Estimated as-grown cultured quartz crystal production in the United States rose to approximately 1 million pounds in 1984 after recovering from a 2-year decline. Based on company reports, total sales in 1984 were 667,000 pounds, and yearend stocks rose to 134,000 pounds from about 53,000 pounds at the beginning of the year.

Natural electronic-grade quartz continued to decline and has been replaced by cultured quartz for most applications. As an indication of the move from natural to cultured quartz, the National Material Advisory Board under contract from the Federal Emergency Management Administration was assessing the advisability of replacing some of the natural quartz in the National Defense Stockpile with cultured quartz. However, imported natural quartz crystals continued to be required as seed material for growing quartz crystals. They were also used for highly sensitive pressure gauges in the petroleum industry.

**Salt.**—Ohio ranked fourth in salt production behind Louisiana, Texas, and New York. These States accounted for 70% of domestic shipments. According to the "1984 Report on Ohio Mineral Industries," Ohio's salt production totaled 4.1 million short tons, 74% over that of 1983, while shipments rose to 3.8 million tons.[2] Rock salt was produced from two underground mines—International Salt Co. in Cuyahoga County and Morton Thiokol Inc. in Lake County—with a total production of 3.5 million tons. There were three brining operations in the State. Diamond Crystal Salt Co. in Summit County and Morton Thiokol in Wayne County produced 617,000 tons of evaporated salt. R. H. Penick produced 16,000 tons of salt in brine. PPG Industries Inc., Chemical Div., abandoned its Summit County brining operations in September 1983. PPG's captive brine production had been used by the company to produce chlorine and caustic soda by electrolysis.

Rock salt for ice control continued to be the primary use of Ohio salt. Salt from artificial brine was used for table salt, food preservation and processing, water treatment, salt licks for livestock, and salt needed for various chemical processes. Also, natural brine was sold for deicing and dust control on secondary roads.

Because 85% of the State's total salt production was used for road salt, Ohio's shipments are subject to the vagaries of winter, government stockpiles, and environmental concerns. About 24% of U.S. production in 1984 was used to deice highways. The 74% increase in Ohio's salt production, which reversed the downward trend of the previous 4 years and a return to 1981 production levels, resulted from a return to more normal demand for deicing salt in 1984. Large quantities had been purchased by State and municipal governments in 1982. These large quantities and the relatively mild winter of 1982-83 combined to reduce demand in 1983, but these stockpiles were consumed during the winter of 1983-84.

Salt consumption by food-related industries remained virtually unchanged; table salt sold to grocery stores declined, indicating that consumers had become more conscious of the allegedly harmful effects of excess salt in the diet and were restricting their intake. Salt sold for animal feed uses also declined in 1984.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

A total of 31.7 million short tons of construction sand and gravel, valued at $104.7 million, f.o.b. plant, was produced in Ohio in 1984. This tonnage is the highest production reported since 1981. It is 28.2% below the record-high production of 1979; but 21.5% higher than that of 1982, when the last complete annual canvass was conducted. An additional estimated 25 million tons of crushed stone and about 3.5 million tons of iron and steel slag aggregate were used in 1984 for construction in the State.

In 1984, production was reported from 232 operations—161 with stationary processing plants, 30 with portable plants, 5 with both stationary and portable plants, 17 pit-run or unspecified operations, and 19 dredging operations. Three of the Nation's top 10 producers of construction sand and gravel had operations in Ohio—American Aggregates Corp. with 12 operations, Dravo Corp. with 6, and Koppers Co. Inc. with 2.

Also, Ohio ranked fourth in the Nation behind California, Texas, and Michigan in 1984 production of construction sand and gravel. Compared with the estimated 1983 tonnage and value of production, 1984 Ohio sales increased 17% and 24%, respectively, whereas total U.S. output and value increased 18% and 16%, respectively.

The State's sand and gravel producers were greatly impacted in 1984 by an additional soundness test to determine the quality of asphalt aggregate when the Ohio Department of Transportation (ODOT) Division of Test instituted a slotted screen test as a supplement to the conventional sodium sulfate soundness test. Silt stone, defined as a fine-grained sandstone particle, was present in most sand and gravel deposits from Fredericktown eastward into Pennsylvania and was causing popouts. Most gravel paving mixes in northeast Ohio had always experienced this problem, but not to the point of being detrimental to pavement performance. However, when early raveling and payment deterioration occured on a large resurfacing project in the Youngstown area, excessive silt stone was felt to be a major factor. The implementation of the additional test procedure caused some delays in getting material approved by ODOT and resulted in a number of producers modifying their excavating and processing procedures.

**Table 7.—Ohio: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 5,651 | $17,810 | $3.15 |
| Plaster and gunite sands | 159 | 509 | 3.21 |
| Concrete products | 410 | 1,286 | 3.14 |
| Asphaltic concrete | 3,149 | 10,903 | 3.46 |
| Road base and coverings[1] | 2,581 | 8,669 | 3.36 |
| Fill | 3,299 | 6,341 | 1.92 |
| Snow and ice control | 156 | 475 | 3.04 |
| Other[2] | 16,344 | 58,715 | 3.59 |
| Total[3] or average | 31,748 | 104,709 | 3.30 |

[1] Includes road and other stabilization (cement).
[2] Includes roofing granules and other unspecified uses.
[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—A total of 1.5 million tons of industrial sand and gravel, valued at $20.8 million, f.o.b. plant, was produced in Ohio in 1984. Production and value, reported by 7 companies at 10 operations, increased 23% and 17%, respectively, over 1983 levels. All of the State's production came from crushed sandstone and conglomerate. The primary uses for the State's industrial sand were foundry sand, glass sand, and silica flour.

Metallurgical pebbles were also produced from crushed conglomerate. Other uses were for refractory, silicon carbide, flux, blasting, fillers, filtration, fracking, grinding, roofing granules, and cement manufacture. Ohio ranked sixth nationally in both quantity and value of its production in 1984.

Walter C. Best Inc. at two operations in Geauga County produced foundry and fracking sand. Central Silica Co. at two operations in Knox and Perry Counties produced glass sand, silica flour, and foundry sand. Central Silica is a subsidiary of Oglebay Norton Co. of Cleveland, 1 of the Nation's top 10 producers of industrial sand. Southern Silica Inc. at its Ross County operation produced glass sand, foundry sand, and traction sand. Best, Central Silica, and Southern Silica, the State's leading companies in order of total output, also produced industrial sand for other uses. R. W. Sidley Inc., Geauga County, was the State's sole producer of industrial gravel—metallurgical pebble.

**Slag—Iron and Steel.**—In 1984, Ohio ranked second in the Nation in both quantity and value of processed slag. Because of the modest increases in the State's production of iron and steel in 1984, slag production increased only 2% over that of 1983 to 3.7 million short tons. Value increased by 11.8% to $16.9 million, in part, because of increased construction activity.

In 1984, 8 companies at 17 operations produced both air-cooled and water-granulated iron slag and processed steel slag for construction materials. Air-cooled iron slag was used mainly for road base, fill, and concrete and asphaltic aggregate. Water-granulated iron slag was used as lightweight aggregate. The main growth areas for iron slag included replacement for cement in concrete construction, use in bituminous mixtures, and use in lightweight concrete applications. Steel slag was typically used as road base, fill, and asphaltic concrete aggregate or recycled to the blast furnace. Steel slag usage for asphaltic concrete aggregate was expected to be a major growth area. Statistics developed by the U.S. Bureau of Mines indicated that about 60% of steel slag was recycled to blast furnaces in 1984.

The Ohio Aggregate Association has estimated that 3.5 million tons of slag aggregate in 1984 was used for construction in the State. This represented about 6.5% of the 53.6 million tons of crushed stone and processed sand and gravel that was produced by the State's construction aggregates industry in 1984.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—A total of 38.5 million short tons of crused stone valued at $139 million, f.o.b. plant, was estimated to have been produced in Ohio in 1984. This tonnage was the fifth largest production ever recorded in Ohio, ranking the State ninth in the Nation; yet output was 24% below the record-high production of 1979. The quantity and value of sales in the State increased 17% and 22%, respectively, over 1983 levels. These increases were among the most significant in the major producing States.

Almost all of the State's crushed stone was produced from sandstone and conglomerate; less than 1% was produced from limestone and dolomite. Almost all of the State's crushed sandstone and conglomerate was used primarily for industrial sand and gravel; a minor amount was used for construction aggregate. The primary uses for crushed limestone and dolomite were for construction aggregate, cement manufacture, acid water treatment, stone dust, agricultural limestone, and mine dusting. Other uses included high-value-added products, such as lime, flux stone, dead-burned dolomite, and whiting-whiting substitutes.

*Dimension.*—In 1984, an estimated 500,000 cubic feet of dimension stone, valued at $3.5 million was produced in Ohio. Quantity decreased by 24%, while value increased 18%. Although Ohio continued to lead the Nation in production of dimension sandstone, its share of the total domestic building stone market was only 3%. The State's production was used for sawed and cut stone, rough irregular-shaped stone, flagging, and curbing. A minor amount of rough irregular-shaped limestone blocks was also quarried.

**Strontium Compounds.**—Barium & Chemicals Inc., Steubenville, continued to produce various strontium compounds from shipments of strontium carbonate produced in the United States from Mexican celestite ore. The major end use was in the manufacture of color television tubes, which contain 5% to 7% strontium oxide, supplied as strontium carbonate. There was a decline in consumption for this end use with the closure of a large television picture tube plant in 1983. Another major end use of the carbonate was in the manufacture of ferrite ceramic magnets.

Strontium nitrate, used in pyrotechnics and signals, continued as the second largest end use. Other compound uses included chromate, which was used as a corrosion inhibitor in pigments; phosphate, which was used in the manufacture of fluorescent light; and chloride, which was used in the manufacture of toothpaste for sensitive teeth.

**Sulfur (Recovered).**—Elemental sulfur was recovered as a nondiscretionary byproduct from petroleum refining operations by Standard Oil Co. of Ohio at its refineries in Lima and Toledo and Ashland Oil Inc. at Canton. Also, LTV Steel recovered sulfur from its coking plants in Cuyahoga and Trumbull Counties. Production in Ohio remained essentially unchanged while value increased 4% over that of 1983.

**Talc.**—The AFC Corp. Canfield operations in Mahoning County processed crude ore imported from France. Ground talc, shipped within Ohio and to Pennsylvania, West Virginia, and Texas, was used in ceramics.

**Titanium Dioxide Pigments.**—SCM Corp., SCM Pigments Group, manufactured titanium dioxide at its two Ashtabula plants. Titanium dioxide is a white pigment and opacifer used in the manufacture of paint, paper, plastics, and rubber products. The plants' combined annual pigment capacity was 86,000 short tons by the chloride process. In 1984, SCM was spending $25 million to upgrade the technology and expand the capacity of the plant that it acquired from Gulf + Western Industries Inc. (G+W) in 1983.

**Vermiculite (Exfoliated).**—Ohio yielded first place in production of exfoliated vermiculite to California, yet continued to lead in the value of production among the 28 producing States. In 1984, sales increased 17.6% in quantity and 20% in value. O. M. Scott & Sons Co. in Marysville, Union County, became the State's sole producer of exfoliated vermiculite in 1984 when Cleveland Builders Supply discontinued operations.

O. M. Scott exfoliated vermiculite for captive use as a fertilizer carrier. The company sold fertilizer and control products for turf grass, ornamentals, and vegetable gardens throughout the United States and for export. Scott was acquired by International Telephone & Telegraph Corp. (ITT) in 1984. Cleveland Gypsum, which reported neither production nor sales in 1984, had produced loose fill, block, and high-temperature insulation.

Nationally, the consumption of exfoliated vermiculite for agricultural uses increased slightly over those of 1983, whereas insulation uses increased 7%. The principal mining and beneficiation operation continued to be that of W. R. Grace & Co. in Montana and South Carolina. The ore was also mined in Virginia.

## METALS

**Aluminum.**—Ormet Corp., 66% owned by Consolidated Aluminum Corp. (Conalco) and 34% owned by Revere Copper & Brass Inc., produced primary aluminum in Hannibal. Alumina for the State's sole producer of primary aluminum was produced at its Burnside, LA, refinery from Sierra Leone bauxite. Conalco, the 66% owner, operated a rolling mill, also in Hannibal, and produced sheet and plate for nationwide markets.

As the economic recovery that began in mid-1983 continued into early 1984, Ormet restarted two idled potlines in the first quarter. The six-potline plant was brought to full operating capacity (270,000 short tons per year) and 450 laidoff workers were recalled. Ormet closed out the year with all six potlines active, although perhaps at reduced power. In contrast, the U.S. primary aluminum industry increased its operating rate from 78% in January to 87% at midyear and cut back to 78% by yearend. In 1984, foreign sources of aluminum gained a larger share of U.S. markets, and net imports rose to a record-high level as world production increased, also to record high levels.

The leveraged buyout of U.S. Reduction Co. from American Can Co. by executives in the secondary aluminum industry resulted in the late-year startup of the mothballed 40-million-pound-per-year U.S. Reduction secondary smelter at Toledo. The new owners viewed the market for ingots from the casting industry as very favorable, noting that "1984 will be one of record shipments and that the casting market had previously peaked in 1979." Also in the secondary aluminum market, Vulcan Materials Corp. closed its 50-million-pound-per-year ingot plant in Sandusky and transferred a portion of this total output to the company's other three plants—one in Arkansas and two in California. The company's aluminum billet plant in Sandusky was not affected by the closure of the ingot plant.

Also, Aluminum Smelting & Refining Co., the fourth largest smelter in the United States and the largest in Cleveland, planned to expand its more efficient Painesville Township plant and phase out its Maple Heights plant in response to the substantial drop in ingot prices.

**Beryllium.**—Brush Wellman Inc., with administrative offices and research and development facilities in Cleveland, produced beryllium alloys (primarily beryllium-copper), beryllia ceramics, and metallic beryllium at its Elmore plant for worldwide markets. Brush Wellman's other Ohio operations include its S. K. Wellman Corp. subsidiary, which manufactures specialty, high-energy fraction materials at Bedford, and its Bucyrus Blades Inc. subsidiary, which manufactures impact and abrasion-resistant cutting edges at Bucyrus.

Brush Wellman was the Western World's only fully integrated producer of products containing beryllium. Beryllium ore concentrate from the Delta, UT, plant was used in all beryllium-containing products. This plant is capable of processing bertrandite from the company's Juab County, UT, mine as well as imported beryl ore.

By September, Brush Wellman reported that its backlog of orders was at a new record high as consumption of beryllium metal and beryllium product showed record strength in 1984. Brush Wellman was awarded a $13,467,000 contract in late September to supply the General Services Administration (GSA) with 60,000 pounds of 98% beryllium metal for the U.S. National Defense Stockpile to be delivered by the end of 1985. However, demand for the metal from GSA, the U.S. Department of Defense, and the aerospace industries were only part of the 1984 increased sales. Demand grew for beryllium-copper strip, used in electronic application; and beryllium-copper rod, bar, tube extrusion, and billets, used increasingly by the oil sector for instrument housings, measuring systems, and drilling applications. Beryllium for brushings and welding tips also increased. Additionally, the company's beryllia ceramic line operated at nearly full capacity. This material was used for semiconductor packages and chip carriers. The largest consumption increases came from the electronics industry in 1984, while defense and aerospace uses remained beryllium's largest market.

In mid-1984, Brush Wellman doubled copper rod, bar, and tube capacity at its Elmore plant. The project included a computer-controlled electric furnace complex, two draw benches for cold-working large-diameter and long-length tubular products, and processing improvements. Also, Brush Wellman announced plans to spend $30 million for new casting furnaces and rolling equipment at the Elmore plant and another $4 million to construct facilities to reclaim beryllium and copper from waste material at the plant.

**Copper.**—The Nippert Co., a subsidiary of Outokumpu, Finland, was proceeding with plans to construct a 30-million-metric-ton-per-year, $4 million copper rod and wire mill adjacent to its existing plant in Delaware, OH. Nippert, a manufacturer of drawn copper shapes and cold-formed components, also produced heat sinks for power electronic applications and dispersion-hardened copper for use in resistance welding. The new mill, scheduled to begin operations in early 1985, was designed to produce both high-chemical and surface quality rod and wire with special emphasis on material to be cold-headed or used in cryogenic applications.

Initial production was expected to be 15 million pounds per year with 50% for captive consumption and 50% to be sold under the name Coppermetal Rod & Wire, a division of Nippert.

**Ferroalloys.**—The quantity and value of Ohio ferroalloy shipments increased 28% and 31%, respectively, over 1983 levels owing to increased demand by the steel, ferrous foundry, and aluminum industries. The State's six producing companies shipped 411,315 short tons, valued at $273 million, from eight plants. Ohio again led the United States in shipments and accounted for 36% of total U.S. tonnage.

Norway's Elkem A/S, one of the world's largest ferroalloy producers, raised its participation in Elkem Metals Co. from 49% to 67% in 1984. Elkem Metals operated plants in Ashtabula and Marietta, as well as West Virginia and New York. Also in 1984, Globe Metallurgical Div. of Interlake Inc., a major producer of ferroalloys and silicon metal, was sold to Moore McCormack Resources Inc. The $37 million sale included the Globe headquarters and plant at Beverly and a plant in Selma, AL. Including management, about 350 people are employed at both operations. The plants manufactured silicon metal and ferroalloys for the aluminum, silicone chemical, and steel and iron foundry industries. Pickands Mather & Co., Cleveland, had been the exclusive sales agent for Globe for over 30 years, and products would continue to be marketed under the Globe trademark. On September 1, Ohio Ferro-Alloys Corp. ceased production of ferrosilicon at its Philo plant. At the time of closure, only two of the seven electric furnaces were in use for the production of ferrosilicon. While the Philo plant was idle, the company maintained its silicon metal production in Alabama but ceased production of silicon metal at its Powhatan Point plant. In the fourth quarter, Foote Mineral Co. reduced operations at its ferrovanadium plant at Cambridge. The plant's two furnaces were shut down throughout October and November to reduce inventory and the high cost of maintenance.

**Iron and Steel.**—The Ohio steel industry witnessed a revival in 1984 as raw steel production and shipments continued to recover from the very low levels of 1982. Although imports rose to record high levels, capacity utilization remained low, and strong competition restrained prices, yet the State's steel shipments increased about 5% compared with those of 1983.

In 1984, Ohio's production, shipment, and consumption of pig iron were 9.6, 9.8, and 10.3 million short tons, respectively, an increase of 3.2%, 5.2%, and 8.2%, respectively, over 1983 levels. The State's raw steel production was 15.4 million tons, 5.8% over that of 1983. Ohio produced 16.7% of the Nation's steel in 1984 and continued to rank as the Nation's No. 2 steelmaker.

Jones & Laughlin Steel Corp., a subsidiary of LTV Corp., and Republic Steel Corp. merged to form the LTV Steel Co. The new LTV Steel, the second largest domestic steel producer, had about 24 million tons per year of raw steel capacity. However, as operations are consolidated, capacity was expected to be reduced to 19 million tons. As one of the conditions of the June merger, the new company had to divest itself of the stainless steel finishing mill at Massillon. By yearend, the plant was sold to CDH Metals Inc., owner of steel distribution centers.

Major additions to galvanizing capacity, largely in response to the automobile industry's need for better corrosion-resistant sheet, were advanced in Ohio. One was the 400,000-ton-per-year, $50 million line at the Middletown plant of Armco Inc. The other was the Bethlehem Steel, Inland Steel Co., and Pre-Finish Metals Inc. joint venture to build a 400,000-ton-per-year, $80 million line at Pre-Finish Metals' Walbridge plant. At yearend, LTV Steel and Sumitomo Metal Industries Ltd. were forming a $130 million joint venture to produce electrogalvanized sheet at LTV Steel's Cleveland Works.

The integrated steel mills also continued to add continuous casting capacity. United States Steel Corp. at its Lorain Works began production on the new $145 million caster, and LTV Steel was completing a large caster at its Cleveland Works.

The Timken Co. continued construction of a $500 million "greenfield" plant in Canton. The minimill, using electric furnaces, would increase the firm's steel productivity by 200% with a plant capacity of about 500,000 tons per year. The mill will produce high-strength alloy steel bars. Startup was expected in late 1985.

Hunt Steel Co. filed for bankruptcy. The company had installed two electric furnaces, a continuous caster, and a pipe mill at its Youngstown plant, but ran into financial problems during startup.

**Titanium.**—The Timet Div. of Titanium Metals Corp. of America (TMCA) and RMI, the Nation's two leading integrated producers of the metal, produced titanium mill products at their Ohio facilities. The lightweight, high-strength, corrosion-resistant metal was used principally in jet engines and frames, space and missile applications, condenser tubing for power generating plants, and chemical processing applications.

At yearend, negotiations were begun for a leveraged buyout of Timet by a group of investors, including its current top management, and Kelso & Co., a management consulting firm specializing in leveraged buyouts. Allegheny International Inc. and NL Industries Inc., the former 50-50 joint owners of Timet, would each retain 5% shares of the company. Timet, the largest integrated producer of titanium, produced mill products at its rolling mill in Toronto from TMCA-produced ingots.

RMI, the Nation's second leading integrated producer of the metal, made titanium sponge at its Ashtabula facility. The sponge was then processed into semifinished and finished mill products at the company headquarters plant in Niles. United States Steel and National Distillers & Chemical Corp. continued to be the 50-50 joint owners of RMI.

Timet's sponge and ingot capacities were 15,000 short tons and 17,000 tons, respectively, whereas RMI's sponge and ingot capacities were 9,500 tons and 12,000 tons, respectively. Their combined ingot capacities represented 65% of the U.S. total. Demand for mill products increased appreciably in 1984, mainly because of increased orders for commercial and military aircraft, including the B-1B bomber. About 75% of shipments was for aerospace applications.

Consumption of titanium dioxide pigments rose to a new peak for the second consecutive year because of continued economic expansion and increased demand from the homebuilding industry. SCM at the former G+W plant also manufactured titanium tetrachloride, the intermediate raw material used to produce titanium sponge. Domestic consumption of titanium sponge rebounded sharply from the low point reached in 1983.

Imported rutile concentrate, synthetic rutile, and some iron-titanium slag were used in the manufacture of titanium dioxide and titanium tetrachloride. About 98% of U.S. consumption of titanium concentrate in 1984 was for manufacturing titanium pigments. The rest was used mainly for titanium metal.

**Zinc Oxide.**—ASARCO Incorporated at its Columbus refinery produced 17,000 short tons (metal content) of lead-free zinc oxide by the American process, 22% over the depressed level of 1982. Production was from zinc concentrate shipped from the company's Tennessee Mines Div. and from slab zinc. During 1984, the plant operated at 74% of normal operating capacity. The increased production was primarily due to the continued high level of demand from the tire and rubber industries, which was the end use for over 50% of Asarco's zinc oxide production. The company also supplied zinc oxide to the coatings, plastics, chemical, electronics, ceramics, and glass industries. The company also operated a zinc oxide plant in Hillsboro, IL. Because of operating losses at these two plants, Asarco wrote down their value by $5 million in 1984, however, they would continue to operate.

**Zirconium.**—In 1984, eight companies produced zirconium materials in Ohio. Refractories, welding rods, milled zircon, oxides, alloys, zircon ores, ceramics, and ceramic colors were among the products. Zircon, the principal ore of zirconium, was mined as a coproduct of ilmenite and rutile from sand deposits in Florida.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] Ohio Department of Natural Resources, Division of Geological Survey. 1984 Report on Ohio Mineral Industries. 1985, pp. 38, 106.

## Table 8.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Abrasives (manufactured): | | | |
| Carborundum Grinding Co | Box 759<br>Logan, OH 43138 | Plant (bonded abrasives). | Hocking. |
| General Electric Co., Specialty Materials Dept. | 6325 Huntley Rd.<br>Worthington, OH 43085 | Research activities (synthetic diamonds). | Franklin. |
| Globe Steel Abrasives Co | 233 1st Ave., Box 1179<br>Mansfield, OH 44901 | Plant (metallic abrasives). | Richland. |
| National Metal Abrasive Co | 142 Auble St., Box 158<br>Wadsworth, OH 44281 | do | Medina. |
| Steel Abrasives Inc | 2727 Symmes Rd., Box 97<br>Fairfield, OH 45014 | do | Butler. |
| Aluminum (primary): | | | |
| Oregon Metallurgical Corp | Box 176<br>Hannibal, OH 43931 | Plant | Monroe. |
| Beryllium: | | | |
| Brush Wellman Inc | 1200 Hanna Bldg.<br>Cleveland, OH 44115 | do | Ottawa. |
| Cement: | | | |
| Columbia Portland Cement Corp.[1 2 3] | Box 1531<br>Zanesville, OH 43701 | do | Muskingum. |
| General Portland Inc.[1 2] | Box 109<br>Paulding, OH 45879 | do | Paulding. |
| Lone Star Marquette Co.[2] | Box 8, Route 93<br>Pedro, OH 45659 | do | Lawrence. |
| SME Cement Inc.[1 2] | Box 1187<br>Uniontown, PA 15401 | Plants | Stark and Mahoning. |
| Southwestern Portland Cement Co.[1 2] | Box 191<br>Fairborn, OH 45324 | Plant | Greene. |

See footnotes at end of table.

Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Clays: | | | |
| Common: | | | |
| Belden Brick Co | Box 910<br>Canton, OH 44701 | Pits | Tuscarawas. |
| Hydraulic Press Brick Co | Box 7786<br>Independence, OH 44131 | Pit | Cuyahoga. |
| Fire: | | | |
| Crescent Brick Co. Inc.[4] | 50 Portsmouth Rd., Box 368<br>Oak Hill, OH 45656 | Pits | Jackson. |
| Ferroalloys: | | | |
| Ashland Chemical Co | 5200 Blazer Parkway<br>Box 2219<br>Columbus, OH 43216 | Plant | Franklin. |
| Elkem Metals Co., Elkem A/S[5] | Box 80, Lake Rd. East<br>Ashtabula, OH 44004 | Plants | Ashtabula and Washington. |
| Foote Mineral Co., Ferroalloys Div | Box 310<br>Cambridge, OH 43725 | Plant | Guernsey. |
| Interlake Inc., Globe Metallurgical Div.[6] | Box 157<br>Beverly, OH 45715 | do | Washington. |
| Ohio Ferro-Alloys Corp | Box 158<br>Philo, OH 43771 | do | Muskingum. |
| Do | Box 517<br>Powhatan Point, OH 43942 | do | Monroe. |
| Union Carbide Corp., Metals Div | Box 299, Route 7<br>Rd. Four St.<br>Marietta, OH 45750 | do | Washington. |
| Fluorspar: | | | |
| Inverness Mining Co | 29525 Chagrin Blvd.<br>Cleveland, OH 44122 | Plant (drying) | Columbiana. |
| Graphite (synthetic): | | | |
| Ohio Carbon Co | 12508 Berea Rd.<br>Cleveland, OH 44111 | Plant | Cuyahoga. |
| Union Carbide Corp | Box J, 200 North Town St.<br>Fostoria, OH 44830 | do | Seneca. |
| Gypsum: | | | |
| Celotex Corp | 320 South Wayne Ave.<br>Cincinnati, OH 45215 | Pit and plant | Ottawa. |
| National Gypsum Co.[7] | 1901 Henderson Dr.<br>Lorain, OH 44052 | Plant | Lorain. |
| United States Gypsum Co.[1] [5] | Gypsum, OH 43433 | do | Ottawa. |
| Iron oxide pigments (synthetic): | | | |
| The Hilton-Davis Chemical Co., Div. Sterling Drug Inc. | Box 37869<br>2235 Langdon Farm Rd.<br>Cincinnati, OH 45222 | do | Hamilton. |
| Iron and steel: | | | |
| Armco Inc., Advanced Materials Div | 1724 Linden Ave.<br>Zanesville, OH 43701 | Mill | Muskingum. |
| Armco Inc., Marion Steel Co | 912 Cheney Ave.<br>Marion, OH 43302 | do | Marion. |
| Copperweld Steel Corp | Box 351, 4000 Mahoning Ave.<br>Warren, OH 44483 | do | Trumbull. |
| Cyclops Corp., Empire Detroit Steel Div. | Box 247, 913 Bowman St.<br>Mansfield, OH 44901 | do | Richland. |
| LTV Steel Co.[8] [9] | 3341 Jennings Rd.<br>Cleveland, OH 44109 | Mills | Cuyahoga and Stark. |
| The Timken Co | 1835 Dueber Ave., SW.<br>Canton, OH 44706 | Mill and plant | Stark. |
| United States Steel Corp., Youngstown Works. | 912 Salt Spring Rd.<br>Youngstown, OH 44509 | Mill | Mahoning. |
| Wheeling-Pittsburgh Steel Corp | South 3d St.<br>Steubenville, OH 43952 | do | Jefferson. |
| Lime: | | | |
| Huron Lime Co | Box 451, 100 Meeker<br>Huron, OH 44839 | Quarry and plant | Erie. |
| LTV Steel Co.[10] | Box 6778, Room 1629<br>Republic Bldg.<br>Cleveland, OH 44101 | Plant | Lake. |
| Martin Marietta Corp.[11] | 755 Lime Rd.<br>Woodville, OH 43469 | Quarry and plant | Sandusky. |
| Ohio Lime Co.[11] | 128 East Main St.<br>Woodville, OH 43469 | Quarries and plants. | Do. |
| Peat: | | | |
| Kalo Inc.[12] | 1145 Chesapeake Ave.<br>Box 12567<br>Columbus, OH 43212 | Bog | Wyandot. |
| Lingvai Peat Co | Route 2, Box 107<br>Edgerton, OH 43517 | Bog | Williams. |
| Sphagnum Moss Peat Farm | 9797 Thompson Rd., Route 1<br>West Liberty, OH 43357 | Bog | Champaign. |
| Perlite (expanded): | | | |
| Celotex Corp.[13] | 320 South Wayne Ave.<br>Cincinnati, OH 45215 | Plant | Hamilton. |
| Cleveland Builders Supply Co.[13] | 2100 West 3d St.<br>Cleveland, OH 44113 | do | Cuyahoga. |

See footnotes at end of table.

## Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Quartz crystal (cultured): | | | |
| Sawyer Research Products Inc | 35400 Lakeland Blvd.<br>Eastlake, OH 44094 | Plant | Lake. |
| Salt: | | | |
| Diamond Crystal Salt Co | Box 149<br>2065 Manchester Rd.<br>Akron, OH 44309 | Well and plant | Summit. |
| International Salt Co | 2400 Ships Channel<br>Cleveland, OH 44101 | Underground mine and plant. | Cuyahoga. |
| Morton Thiokol Inc., Morton Salt Div | Box 390<br>Painesville, OH 44077 | Underground mine, wells, plant. | Lake and Wayne. |
| PPG Industries Inc., Chemical Div.[14] | Box 31<br>Barberton, OH 44203 | Wells and plant | Summit. |
| Sand and gravel: | | | |
| Construction: | | | |
| American Aggregates Corp.[15] | Drawer 160, Garst Ave.<br>Greenville, OH 45331 | Pits and plants (12 operations). | Belmont, Butler, Champaign, Clark, Franklin, Greene, Hamilton, Licking, Warren. |
| Dravo Corp | 5253 Wooster Rd.<br>Cincinnati, OH 45226 | Pits and plants (6 operations). | Butler, Hamilton, Meigs. |
| Industrial: | | | |
| Walter C. Best Inc | Box 87, 11830 Ravenna Rd.<br>Chardon, OH 44024 | Quarry and mill | Geauga. |
| Central Silica Co.[16] | 806 Market St.<br>Zanesville, OH 43701 | Quarries and mills | Knox and Perry. |
| Southern Silica Inc | Box 22, Whiskey Run Rd.<br>Richmondale, OH 45673 | Quarry and mill | Ross. |
| Slag: | | | |
| Iron: | | | |
| Standard Slag Co.[1] [17] | Box 1378<br>Youngstown, OH 44501 | Plants (5 operations). | Cuyahoga, Jefferson, Trumbull. |
| United States Steel Corp | 1807 East 28th St.<br>Lorain, OH 44055 | Plant | Lorain. |
| Iron and steel: | | | |
| Heckett Co | Box 1071, N. Main St.<br>Butler, PA 16001 | Plants (3 operations). | Richland, Stark, Trumbull. |
| Stein Inc | Box 31178<br>Cleveland, OH 44131 | Plants (2 operations). | Cuyahoga and Lorain. |
| Stone: | | | |
| Crushed: | | | |
| American Aggregates Corp | Drawer 160, Garst Ave.<br>Greenville, OH 45331 | Quarries and plants. | Clark, Fayette, Franklin, Greene, Montgomery, Warren. |
| The France Stone Co.[3] | Box 1928, 1800 Toledo Trust<br>Toledo, OH 43603 | Quarries and plant | Lucas, Sandusky, Seneca, Wood. |
| Martin Marietta Refractories | 755 Lime Rd.<br>Woodville, OH 43469 | Quarry and plant | Sandusky. |
| National Lime & Stone Co | First National Bank Bldg.<br>Findlay, OH 45840 | Quarries and plants. | Allen, Auglaize, Crawford, Delaware, Hancock, Marion, Putnam, Wyandot. |
| Sandusky Crushed Stone Co. Inc., a subsidiary of Ralph Rodgers Co. | Box 527<br>Sandusky, OH 44870 | Quarry and plant | Erie. |
| SME Lime & Chemical Co | Box 1187<br>Uniontown, OH 15401 | Quarries and plant | Lucas. |
| Dimension: | | | |
| Briar Hill Stone Co | Box 148, State Route 520<br>Glenmont, OH 44628 | do | Coshocton, Holmes, Knox. |
| Cleveland Quarries Co.[18] | Quarry Rd.<br>Amherst, OH 44001 | Quarry and plant | Lorain. |
| The France Stone Co | Box 1928, 1800 Toledo Trust<br>Toledo, OH 43603 | Quarries and plant | Seneca. |
| Waller Bros. Stone Quarry Co | 134 County Rd.<br>McDermont, OH 45652 | do | Scioto. |
| Sulfur (recovered): | | | |
| Standard Oil Co. of Ohio | 1750 Midland Bldg.<br>Cleveland, OH 44115 | Refineries | Allen and Lucas. |
| Talc (ground): | | | |
| AFC Corp., Pine Lake Clay Div | Western Reserve Rd.<br>Canfield, OH 44406 | Plant | Mahoning. |
| Titanium: | | | |
| RMI Co | Box 269, 1000 Warren Ave.<br>Niles, OH 44446 | Plants | Ashtabula and Trumbull. |
| Timet Div., Titanium Metal Corp. of America. | 100 Titanium Way, Box 309<br>Toronto, OH 43964 | Mill | Jefferson. |

See footnotes at end of table.

Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Titanium dioxide: | | | |
| SCM Corp., SCM Pigments Group | 2900 Middle Rd.<br>Ashtabula, OH 44004 | Plants | Jefferson. |
| Vermiculite (exfoliated): | | | |
| Cleveland Builders Supply Co.[18] | 2100 West 3d St.<br>Cleveland, OH 44113 | Plant | Cuyahoga. |
| O. M. Scott & Sons Co.[19] | 14111 Scottslawn Rd.<br>Marysville, OH 43047 | do | Union. |
| Zinc oxide: | | | |
| ASARCO Incorporated[20] | Box 327<br>Columbus, OH 43216 | do | Franklin. |

[1] Also crushed stone.
[2] Also clays.
[3] Formerly Columbia Cement Corp., acquired by SME Industries Inc.
[4] Formerly Cedar Heights Clay Co.
[5] Also lime.
[6] Sold in November to Moore McCormack Resources Inc.
[7] Also expanded perlite.
[8] Formed in June by the merger of J & L Steel Corp. and Republic Steel Corp.
[9] Also sulfur (recovered).
[10] Formerly Republic Steel Corp.
[11] Refractory dead-burned dolomite and dolomitic lime.
[12] Formerly Agricultural Laboratories Inc.
[13] Discontinued operations in 1984.
[14] Abandoned operations in September 1983.
[15] Also iron slag.
[16] Subsidiary of Oglebay Norton Co., Cleveland, OH.
[17] Also construction sand and gravel.
[18] Also natural abrasives.
[19] Acquired by International Telephone & Telegraph Corp. (ITT) in 1984.
[20] Also sulfuric acid.

# The Mineral Industry of Oklahoma

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Oklahoma Geological Survey for collecting information on all nonfuel minerals.**

## By Lorraine B. Burgin[1]

The value of nonfuel minerals in Oklahoma rose to $246 million in 1984, surpassing 1981's record high of $235 million. Construction materials continued to represent most of the output value, with cement, crushed stone, construction sand and gravel, and gypsum leading the commodities, followed by industrial sand and gravel, iodine, lime, clays, and feldspar. Of the minerals surveyed, value of production increased in all except iodine, lime, and salt; a decline in quantity of production was noted only in iodine. Nationally, Oklahoma ranked first in output of iodine and second in crude gypsum and tripoli.

**Table 1.—Nonfuel mineral production in Oklahoma[1]**

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Cement: | | | | |
| Masonry ---- thousand short tons-- | 45 | $3,074 | 49 | $3,506 |
| Portland ---- do---- | 1,719 | 83,685 | 1,732 | 84,701 |
| Clays ---- do---- | 862 | 2,288 | 979 | 2,498 |
| Gem stones | NA | 2 | NA | 2 |
| Gypsum ---- thousand short tons-- | 1,351 | 11,571 | 1,549 | 13,485 |
| Pumice ---- do---- | 1 | W | W | W |
| Sand and gravel: | | | | |
| Construction ---- do---- | $^{e}$7,500 | $^{e}$17,300 | 10,984 | 26,582 |
| Industrial ---- do---- | 1,184 | 13,221 | W | W |
| Stone: | | | | |
| Crushed ---- do---- | 23,865 | 76,941 | $^{e}$25,500 | $^{e}$86,000 |
| Dimension ---- do---- | 10 | 737 | $^{e}$12 | $^{e}$771 |
| Combined value of feldspar, iodine, lime, salt, tripoli, and values indicated by symbol W | XX | 17,367 | XX | 28,187 |
| Total | XX | 226,186 | XX | 245,732 |

$^{e}$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Oklahoma, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Atoka | (2) | $1,900 | Stone (crushed). |
| Beaver | W | W | Pumice. |
| Blaine | W | W | Gypsum. |
| Bryan | W | W | Stone (crushed). |
| Caddo | $2,278 | W | Stone (crushed), gypsum. |
| Canadian | W | 138 | Clays. |
| Carter | (2) | -- | |
| Cherokee | (2) | W | Do. |
| Choctaw | 768 | W | Stone (crushed). |
| Cleveland | 1,382 | (3) | |
| Coal | (2) | W | Stone (crushed). |
| Comanche | W | W | Stone (crushed), gypsum. |
| Cotton | 1,278 | (3) | |
| Craig | (2) | 1,012 | Stone (crushed). |
| Creek | W | W | Stone (crushed), clays. |
| Custer | W | W | Clays. |
| Garfield | W | -- | |
| Garvin | W | (3) | |
| Greer | W | W | Stone (crushed), clays. |
| Harmon | W | W | Salt. |
| Haskell | (2) | W | Stone (dimension). |
| Hughes | W | (3) | |
| Jackson | W | W | Gypsum. |
| Johnston | W | W | Sand (industrial), stone (crushed), stone (dimension). |
| Kay | 599 | W | Stone (crushed). |
| Kingfisher | W | W | Iodine. |
| Kiowa | (2) | W | Stone (crushed), stone (dimension). |
| Le Flore | W | W | Clays, stone (dimension). |
| Logan | W | (3) | |
| McClain | W | (3) | |
| McCurtain | 565 | 896 | Stone (crushed). |
| McIntosh | (2) | W | Do. |
| Major | (2) | W | Do. |
| Marshall | (2) | W | Do. |
| Mayes | W | W | Cement, stone (crushed), clays. |
| Murray | W | 7,426 | Stone (crushed). |
| Muskogee | W | W | Feldspar, sand (industrial). |
| Noble | (2) | W | Do. |
| Nowata | -- | W | Stone (crushed). |
| Oklahoma | W | W | Clays. |
| Okmulgee | (2) | W | Stone (crushed). |
| Osage | (2) | 1,473 | Do. |
| Ottawa | W | W | Stone (crushed), abrasives. |
| Pawnee | W | 2,346 | Stone (crushed). |
| Payne | W | 500 | Do. |
| Pittsburg | W | W | Stone (crushed), stone (dimension). |
| Pontotoc | 31,896 | W | Cement, sand (industrial), stone (crushed), clays. |
| Pottawatomie | W | (3) | |
| Pushmataha | W | (3) | |
| Rogers | 407 | W | Cement, stone (crushed), clays. |
| Seminole | W | W | Stone (crushed), clays. |
| Sequoyah | W | W | Lime, stone (crushed). |
| Texas | W | (3) | |
| Tillman | (2) | -- | |
| Tulsa | 3,016 | W | Stone (crushed). |
| Wagoner | 180 | (3) | |
| Washington | (2) | W | Stone (crushed). |
| Woodward | W | W | Iodine, stone (crushed), gypsum. |
| Undistributed[4] | 97,508 | 193,195 | |
| Sand and gravel (construction) | XX | [e]17,300 | |
| Stone: | | | |
| Crushed | [e]84,200 | XX | |
| Dimension | [r] [e]589 | XX | |
| Total | [r] [5]224,665 | 226,186 | |

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[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No production of nonfuel mineral commodities was reported for counties not listed.

[2]Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[3]Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4]Includes gem stones and some sand and gravel (construction, 1982) that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Oklahoma business activity

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Employment and labor force, annual average: | | | |
| Population thousands | 3,226 | 3,310 | 3,298 |
| Total civilian labor force do. | 1,486 | 1,552 | 1,548 |
| Unemployment do. | 85 | 140 | 109 |
| Employment (nonagricultural): | | | |
| Mining total do. | 105.6 | 77.7 | 75.0 |
| Metal mining[1] do. | .1 | .1 | .1 |
| Nonmetallic minerals except fuels[1] do. | 1.7 | 1.7 | 1.7 |
| Coal mining[1] do. | 1.7 | 1.2 | 1.2 |
| Oil and gas extraction do. | 102.1 | 74.7 | 72.0 |
| Manufacturing total do. | 180.8 | 166.2 | 174.1 |
| Primary metal industries do. | 5.0 | 3.9 | 4.1 |
| Stone, clay, and glass products do. | 10.7 | 10.9 | 11.0 |
| Chemicals and allied products[1] do. | 2.1 | 2.1 | NA |
| Petroleum and coal products do. | 8.4 | 8.4 | 8.6 |
| Construction do. | 55.7 | 52.4 | 51.0 |
| Transportation and public utilities do. | 70.7 | 66.3 | 64.5 |
| Wholesale and retail trade do. | 289.4 | 284.5 | 288.3 |
| Finance, insurance, real estate do. | 61.2 | 62.8 | 64.6 |
| Services do. | 216.0 | 215.5 | 221.6 |
| Government and government enterprises do. | 237.2 | 245.2 | 245.5 |
| Total do. | 1,216.6 | 1,170.6 | 1,184.6 |
| Personal income: | | | |
| Total millions | $35,739 | $36,013 | $38,438 |
| Per capita | $11,080 | $10,880 | $11,655 |
| Hours and earnings: | | | |
| Total average weekly hours, production workers | 39.5 | 40.5 | 41.6 |
| Total average hourly earnings, production workers | $8.69 | $9.21 | $9.64 |
| Earnings by industry: | | | |
| Farm income millions | $694 | $400 | $599 |
| Nonfarm do. | $24,895 | $24,815 | $26,238 |
| Mining total do. | $3,541 | $2,594 | $2,561 |
| Metal mining do. | ([2]) | W | W |
| Nonmetallic minerals except fuels do. | $35 | $36 | $38 |
| Coal mining do. | $52 | W | W |
| Oil and gas extraction do. | $3,453 | $2,516 | $2,474 |
| Manufacturing total do. | $4,226 | $4,144 | $4,628 |
| Primary metal industries do. | $129 | $116 | $130 |
| Stone, clay, and glass products do. | $249 | $272 | $287 |
| Chemicals and allied products do. | $89 | $98 | $107 |
| Petroleum and coal products do. | $342 | $352 | $411 |
| Construction do. | $1,369 | $1,386 | $1,512 |
| Transportation and public utilities do. | $1,987 | $2,059 | $2,098 |
| Wholesale and retail trade do. | $4,186 | $4,170 | $4,376 |
| Finance, insurance, real estate do. | $1,195 | $1,368 | $1,454 |
| Services do. | $3,786 | $4,129 | $4,480 |
| Government and government enterprises do. | $4,536 | $4,890 | $5,050 |
| Construction activity: | | | |
| Number of private and public residential units authorized | 28,741 | 40,125 | 22,004 |
| Value of nonresidential construction millions | $835.6 | $785.9 | $791.4 |
| Value of State road contract awards do. | $179.1 | $195.4 | $203.6 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,912 | 1,824 | 1,811 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $224.7 | $226.2 | $245.7 |
| Value per capita | $70 | $68 | $75 |

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Oklahoma Employment Security Commission.

[2] Less than 1/2 unit.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

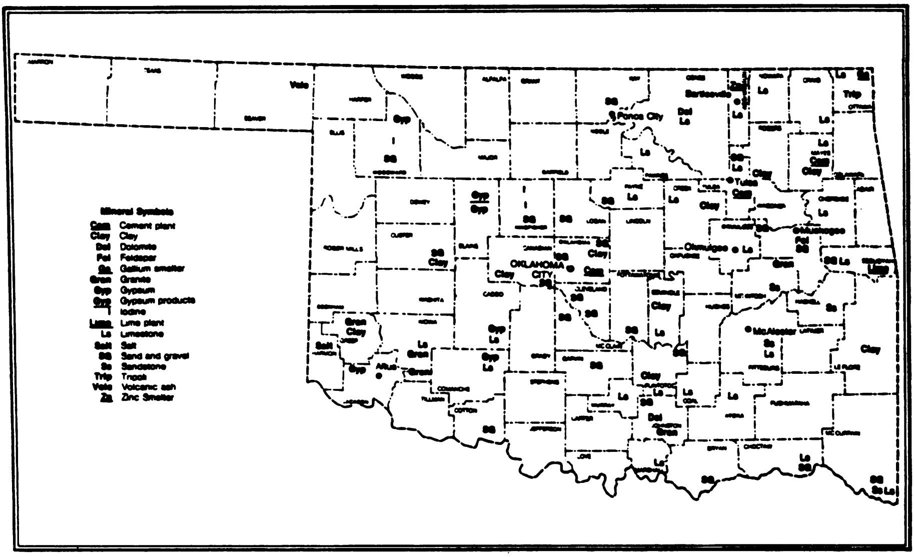

Figure 1.—Principal mineral producing localities in Oklahoma.

**Trends and Developments.**—The Center for Economic and Management Research at the University of Oklahoma reported that definite weaknesses were beginning to develop in Oklahoma's economy. Although some gains were made in retail sales and income, in manufacturing, and in the volume of oil production, total construction activity fell nearly 23% in 1984. Sharp drops were noted in residential, industrial, and institutional nonresidential construction; however, commercial construction and streets and highways posted increases. The unemployment rate declined to 7.2% in 1984 from 9.1% in 1983.[2]

Mining employees, including those in oil and gas production, declined from 77,700 in 1983 to 75,000 in 1984.[3] According to the Oklahoma Employment Security Commission, the oil and gas production industry employed 72,000 in 1984, a 3.6% drop from that of 1983. Average employment in the coal mining industry steadied at 1,200 workers in 1984, the same as that of 1983. In the nonfuel, nonmetallic mining industry, employment was also the same as that of 1983, 1,700 workers, and in the metal mining industry, the number of workers remained about 100.

**Exploration Activities.**—Exploration for nonfuel minerals in the State was limited, however, several instances were reported. Two religious groups, claiming the discovery of submicroscopic gold, leased acreages for mining in the Caney and Mount Carmel areas south of Atoka, Atoka County. Molybdenite mineralization occurring as fracture fillings and as disseminations in a 10-foot-wide zone in the Wichita Mountains province of southwestern Oklahoma was noted, and at the T. Boone Pickens School of Geology, Oklahoma State University, a project was initiated to examine the genesis and extent of the mineralization found in the Reformatory Granite at the Willis Quarry, Greer County.[4]

**Legislation and Government Programs.**—On April 30, 1984, the U.S. Office of Surface Mining (OSM) took over the Oklahoma Department of Mines responsibility for inspecting and regulating the quality of Oklahoma's strip mines. OSM charged the State with lax enforcement of Federal mining laws, violation of Oklahoma regulations, and disregard of public complaints about environmental dangers. In its first such takeover under the 7-year-old mining law, OSM assumed responsibility for inspections and assessment of fines, but allowed the Oklahoma Department of Mines to continue to issue and review mining permits.

During the year, Oklahoma took steps to regain full control of the surface coal mining regulatory program. The State legislature nearly doubled the Oklahoma Department of Mines budget and number of employees, bringing the total from $1.2 million and 29 employees in fiscal year 1984 to $2.2 million and 49 employees in fiscal year 1985. The Oklahoma Department of Mines submitted a plan to OSM that called for the State to resume inspecting mines first in Okmulgee and McIntosh Counties November 15, to expand to a multicounty region by December 15, and statewide by February 15, 1985.

In October 1984, the President signed into law a bill providing for a $20.5 million study and demonstration project to determine methods of halting depletion of ground water supplies in the Ogallala aquifer and ways to replenish underground reservoirs. Known as the High Plains States Groundwater Demonstration Program Act, the legislation affected 156,000 square miles in Oklahoma and parts of Colorado, Kansas, Nebraska, South Dakota, Texas, and Wyoming.

The Oklahoma Geological Survey published Special Publication 84-2, a revised and updated catalog of the Oklahoma Geological Survey Core and Sample Library of well cores, on the South Campus of the University of Oklahoma. The catalog contains 2,306 records of the cores identified by locality, operator, owner, depth, and geologic formation. In existence since 1937, the library stored an extensive collection of cores from coal-bearing rocks and other economic mineral deposits.[5]

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Cement.**—Cement producers in Oklahoma included Blue Circle Inc. (formerly Martin Marietta Corp.'s Martin Marietta Cement Western Div.) at Tulsa, Ideal Basic Industries Inc. at Ada, and Lone Star Industries Inc. at Pryor.

Production of finished portland cement increased 4.6%, and shipments of gray and white finished portland cement increased slightly. Shipments of gray and white finished portland cement, classified as general use and moderate heat type, declined in quantity and value. Shipments of other varieties of gray cement, such as high-early-strength, high-sulfate-resistance, and oil well, increased in tonnage and value. Finished portland cement was used principally by ready-mixed concrete companies, followed by building material dealers, highway contractors, concrete product manufacturers, and others. Highway contractors' use rose about 30%, while building materials' use declined 59% from its high consumption in 1983.

Most cement was shipped from plant to terminal by rail, thence to consumers by truck; a small amount was barged from the terminal to consumers. Prepared masonry cement produced and used rose with the value of sales, increasing more than 14%. Principal raw materials consumed included cement rock, limestone, clays, gypsum, shale, iron ore, and sandstone. Consumption of natural gas, the chief fuel used in the manufacture of cement, declined, while the amount of electricity purchased rose. The very small amount of bituminous and anthracite coal used increased slightly.

**Clays.**—Production of clay and shale continued to increase in quantity and value. Common clay and shale was used principally in manufacturing portland cement, pottery, face and common brick, and lightweight aggregates. The aggregates are used mostly in fabricating lightweight blocks and structural products. The average unit value declined from $2.66 in 1983 to $2.55 in 1984.

In late 1984, after a 2-year shutdown, Acme Brick Co. started a multimillion dollar expansion and modification of its Tulsa brick plant. The annual capacity was to be increased from 25 to 45 million bricks per year, with the replacement of periodic kilns by a computerized continuous tunnel kiln and automated equipment for setting and stacking.

Merry Companies of Augusta, GA, acquired the Oklahoma Brick Corp., which had clay pits at Union City and Muskogee. The Oklahoma Brick concrete block production facilities in Union City were acquired by Thomas Concrete Rock Products Co. and moved to Oklahoma City.

Frankoma Pottery Co. resumed production from its clay pit and newly constructed plant west of Tulsa. Situated at Sapulpa, Creek County, the original plant, with 79,000 square feet, was destroyed by fire in 1983 and replaced in 1984 with a 55,000-square-foot facility. Of the 140 people employed before the $2 million fire, nearly 80 were rehired when production resumed.

**Feldspar.**—Oklahoma was one of six States reporting feldspar production. Arkhola Sand and Gravel Co. continued to recover feldspar from sands dredged from the bed of the Arkansas River near Muskogee. The acid-washed product was 25% feldspar and 75% quartz and was used by glass industries in the State. The quantity and value of output continued to gradually increase as markets improved.

**Gem Stones.**—Oklahoma's barite rose rocks are found unevenly distributed in a narrow band of Permian Garber Sandstone from Paul's Valley, Garvin County, on the south to Guthrie, Logan County, on the north. Locating and collecting barite roses at an area east of Norman was described in the literature.[6]

**Gypsum.**—Oklahoma rose from being the Nation's third largest producer of crude gypsum in 1983 to second place in 1984. Output increased more than 14%, and its value increased about 16% as the industry expanded.

Production of calcined gypsum increased dramatically in both quantity and value. Republic Gypsum Co. and United States Gypsum Co. operated calcining facilities in the State. Republic Gypsum planned to build a second gypsum wallboard production line parallel to the existing line at its Duke facility. About 75 new jobs were expected to be added upon completion of the new line in October 1985. To fully integrate its operation and to utilize its 1,000-ton-per-day gypsum capacity, the company purchased two paperboard plants from Packaging Corp. of America, a Tenneco Inc. company. In December, U.S. Gypsum became a subsidiary of USG Corp., which was formed as a holding company to provide management for nine operating subsidiaries.

Temple-Eastex Inc. announced construction of an $18 million gypsum mill and wallboard manufacturing plant adjacent to its gypsum quarry near Fletcher. The new plant was expected to produce approximately 300 million feet of gypsum wallboard per year by the second quarter of 1986, and to employ about 100 people on a 7-day schedule. Markets for the wallboard were to include Kansas, Oklahoma, and Texas. On completion of the plant, the Harrison Gypsum Co. Inc. quarry near Cement will supply additional raw material.

**Iodine.**—Most of the iodine produced in the Nation is recovered from brines in Oklahoma; however, in 1984, output declined about 20% in quantity and 25% in value, in part, because of the economy, competition with imports, and until October, with sales of surplus iodine from the General Services Administration stockpile.

Woodward Iodine Operations, 51% owned by PPG Industries Inc. and 49% owned by Amoco Production Co., recovered iodine from brines associated with natural gas at its plant approximately 8 miles northeast of Woodward, Woodward County. The facility was the largest crude iodine recovery unit in the United States. On July 16, the operation was sold to Woodward Iodine Corp., a subsidiary of Asahi Glass Co. Ltd. of Tokyo, Japan, owner of Ise Chemical Industry Co. Ltd., the world's largest producer of iodine. Almost three-fourths of the iodine consumed in the United States was imported, mostly from Japan. Acquisition of the property by Asahi Glass was expected to increase production by providing capital for the drilling of new wells. No new wells had been drilled in the area since 1981, and output was declining at the existing wells.[7]

North American Brine Resources, a joint venture of Beard Oil Co. of Oklahoma City (40%) and two Japanese firms—Godoe USA Inc., a subsidiary of United Resources Industry Co., (50%) and Inorgchem Development Inc., a subsidiary of Mitsui & Co., (10%)—recovered iodine from oilfield waste brines at its miniplants in Dover and Hennessey, Kingfisher County.

Iodine from Oklahoma was used chiefly for catalysts, animal feed additives, pharmaceuticals, disinfectants, and stabilizers, followed by inks and colorants, photographic equipment, iodized salt, smog inhibitors, and other products.

**Lime.**—St. Clair Lime Co. continued underground mining of a high-calcium lime for producing quicklime and hydrated lime at its operation in Marble City, Sequoyah County. By December 1984, the company completed the fourth phase of an expansion and modernization project at its facility, boosting capacity to about 900 short tons per day. Two kilns were improved, and storage, bagging, and loading space was increased. Production rose 5% in quantity, but value declined about 1%.

**Pumice (Volcanic Ash).**—Volcanic ash was mined and processed at Axtell Mining

Corp.'s Beaver No. 1 Mine near Gate, Beaver County, in the eastern Oklahoma Panhandle area. Deposited in a Pleistocene Age lake, the 40- to 70-foot-thick volcanic-ash bed consisted largely of volcanic glass shards, mixed with lesser amounts of clay, feldspar, mica, quartz, and diatom fossils. Output stabilized and value increased during 1984; the product was used mostly in abrasives, with a small amount for road construction and maintenance.

**Salt.**—Salt output remained the same as that of 1983; however, its value declined nearly 7%. Natural brines in Oklahoma originate in shallow underground salt beds in the Permian Flowerpot Shale. Commercial brines are pumped from shallow wells drilled into brine-filled solution cavities in salt beds. Acme Salt Co. at Erick, Harmon County, produced crystal salt from brines evaporated in solar ponds.

Cargill Inc. of Minnesota bought the Blackmon Salt Co. of Freedom and commenced building a 200,000-short-ton-per-year salt processing plant. On completion of construction in early 1985, about 50 people were expected to be employed, processing salt harvested from 10 solar evaporation ponds. Natural underground brines from the Flowerpot salt deposit near the Cimarron River will provide the feeder stock for the new plant on 1,900 acres of land 8 miles west of Freedom, Woods County. Blackmon Salt mined, processed, and marketed the salt for approximately 75 years until the operation was sold to investors in 1981. At its peak, production totaled 30,000 short tons annually.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Production of construction sand and gravel increased about 46% in quantity and nearly 54% in value over that of estimated 1983 data. Leading producers, in descending order of tonnage, included The Dolese Co. with four pits, Anchor Stone Co. with two pits, and seven other producers operating one pit each. Of 106 companies and government agencies with 123 operations and 127 pits, these 9 companies produced 52% of Oklahoma's construction sand and gravel.

*Industrial.*—Industrial sand output fell in volume, but its value inched upward. The unit value of industrial sand was $11.89 per ton in 1984. The two producers were Pennsylvania Glass Sand Corp., with its Oklahoma plant and works near Mill Creek in Johnston County, and Mid-Continent Glass Sand Co., with its Roff pit near Ada in Pontotoc County. In descending order of volume, industrial sands were used for specialty glasses, containers, flat glass, foundry molding and core, ground fiberglass, roofing granules and filler, hydraulic fracturing for stimulating hydrocarbon producing formations, chemicals, scouring cleansers, porcelain pottery, blasting, and refractory purposes.

Pennsylvania Glass Sand announced a $6.6 million modernization and expansion program at four of its operations for producing micrometer-sized ground silica, one of them being the plant in Mill Creek. Automated production and quality assurance equipment, in addition to packaging facilities, were expected to be installed.

**Table 4.—Oklahoma: Construction sand and gravel sold or used in 1984, by major use category.**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,415 | $10,146 | $2.97 |
| Plaster and gunite sands | 263 | 537 | 2.04 |
| Concrete products | 16 | 42 | 2.66 |
| Asphaltic concrete | 443 | 828 | 1.87 |
| Road base and coverings | 449 | 1,009 | 2.25 |
| Fill | 1,589 | 2,546 | 1.60 |
| Other[1] | 4,808 | 11,475 | 2.39 |
| Total[2] or average | 10,984 | 26,582 | 2.42 |

[1] Includes roofing granules and other unspecified uses.
[2] Data may not add to totals shown because of independent rounding.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Preliminary estimates indicated crushed and dimension stone production increased in quantity and value.

Rock producers continued to face environmental problems of quarries placed in suburban or rural areas where homeowners protested the close proximity of the plants. Tulsa Rock Co., a subsidiary of Koppers Co. Inc., sought an extended 5-year surface mining permit to operate its limestone quarry near Owasso in the northwest corner of Rogers County. The company supplied crushed stone to concrete producers and sold other products from riprap to agricultural limestone. Although the operation was carefully planned to minimize dust and noise pollution, residents of the area, in 1984, continued to protest that, under the new 5-year permit law passed by the legislature in 1983, their complaints about the plant would only be heard once every 5 years instead of yearly as it was in the past.

In 1983, The Quapaw Co. constructed a new 600-short-ton-per-hour crushed limestone plant west of Tulsa at Drumright, Creek County. Following the leasing of some 2,000 acres of reserves, the facility was built to replace a closed, smaller nearby plant. Production was from a 12-foot-thick limestone bed overlain by 15 to 30 feet of overburden containing large boulders and shale that were blasted and retained for reclaiming the land. The new plant was ordered in February 1983, construction started in May, and the first limestone crushed on August 29.[8]

The Burlington Northern Railroad obtained granite for ballast at its Clarksdale quarry near Mill Creek, Johnston County. The company estimated the deposit contained a minimum of 85 years' supply based on production of 2 million short tons per year; overburden ranged from zero to 35 feet deep. Construction of the 400-ton-per-hour crushing plant began in January 1981 and was completed in May 1982. With planned expansions and fine tuning of the facility, the plant capacity could be brought up to 1,000 tons per hour should the need arise. The primary market for the product was as ballast on the Burlington Northern Railroad rights-of-way in Arkansas, Colorado, Mississippi, Missouri, Nebraska, Oklahoma, and Texas.[9]

**Sulfur (Recovered).**—Production of sulfuric acid recovered in smelting and refining zinc concentrates increased about 6% in quantity and declined 0.9% in value.

**Tripoli.**—Of three States producing tripoli in the Nation, Oklahoma continued to rank second; Illinois and Arkansas were the other States where the product was mined. Tripoli is a naturally recurring microcrystalline, finely particulated, friable form of silica leached from a siliceous limestone or calcareous chert. The American Tripoli Co. mined tripoli in east-central Ottawa County, northeastern Oklahoma, and processed the material in Seneca, MO, for use as an abrasive in polishing and buffing compounds. Output of tripoli increased 35% in quantity and 38% in value in 1984.

**Vermiculite (Exfoliated).**—W. R. Grace & Co. produced exfoliated vermiculite at its plant in Oklahoma City from raw material shipped in from out of State. Production and sales of the material declined slightly in quantity and value. Uses of the product included block insulation, loose-fill insulation, and concrete aggregate; a small amount was sold for horticultural applications.

## METALS

No ore for the production of metals was mined in Oklahoma during 1984. Several metals, however, were recovered from smelters that used recycled materials from local and out-of-State sources and from ore concentrates from out-of-State producers.

**Gallium.**—Eagle-Picher Industries Inc. produced gallium metal from residues of zinc production at the company's Quapaw plant in Ottawa County.

**Iron and Steel.**—Tublar Corp. of America announced plans to build a 450,000-short-ton-per-year integrated seamless pipe and tube plant next to the company's 180,000-short-ton-per-year tubular processing plant in Muskogee's port area. The new $350 million minimill will utilize an electric arc furnace and advanced treating facilities, continuous casting, and tubemaking techniques and equipment. About 2,000 workers will be employed, compared with 500 in 1984. Pipe for the petroleum industry, line and standard pipe, and mechanical or pressure tubing will be produced.

Allegheny-Ludlum Steel Corp. planned to expand its Claremore, Rogers County, tubing pipe facility to accommodate all the company's production of stainless, specialty alloy, and titanium tubing. Floor space was to be increased from 48,000 to 138,000 square feet. Construction was to begin in January 1985 and was scheduled for completion by the fourth quarter of 1985.

**Vanadium and Uranium.**—No vanadium was produced in Oklahoma in 1984. The Bartlesville vanadium extraction operation of Continental Resources and Development Group Inc. remained idle throughout the year. Constructed in 1979, the chemical leach plant was built to process power station boiler ash, refinery residues, and spent refinery catalysts to recover a 95% to 96% $V_2O_5$ fused-oxide flake. The plant was shut down in 1982 because of technological problems and a plummeting demand for vanadium.

The uranium potential of the Rush Springs Formation in the Cement District of southwestern Oklahoma was described.[10] The only commercial production of uranium in Oklahoma had been at Cement in Caddo and Grady Counties and was found within a west-northwest joint in a sandstone unit near the crest of the Cement anticline. Carnotite and tyuyamunite mineralization occurred disseminated in a series of poorly defined pods 3 to 5 feet wide and 5 to 6 feet deep along a 150-foot length of the upper surface of the southwest-dipping fracture. About 13 tons of ore averaging 2.2% uranium was mined from the Permian Upper Rush Springs Formation. The average uranium-vanadium ratio of the ore was 2:1 and the average calcite content was 9%.

**Zinc and Lead.**—St. Joe Minerals Corp., a wholly owned subsidiary of Fluor Corp., acquired the National Zinc Co. at Bartlesville on August 21. Included in the nearly $16.5 million transaction was National Zinc's 55,000-short-ton-per-year electrolytic zinc refinery and some oil and gas reserves. National Zinc's inventories and accounts receivable were reportedly purchased for $18.5 million. Feed material included zinc concentrates from St. Joe Minerals' mines in Missouri and from three of the company's mines in South America.[11]

In the Picher Field of Ottawa County, OK, and Cherokee County, KS, acidic waters from abandoned lead-zinc mines continued to empty into the Tar Creek drainage system, threatening to contaminate potable water supplies in the Roubidoux aquifer and Grand Lake.

By early 1984, the Governor and the 24-member Tar Creek Task Force announced a cleanup plan consisting of diverting surface water runoff away from mine shafts; plugging 66 abandoned water wells, 40 in Oklahoma and 26 in Kansas; monitoring Roubidoux aquifer water supplies; developing emergency plans for alternative water supplies; and treating remaining acidic waters. The cleanup was estimated to cost more than $3.97 million, with $346,000 of the total to be paid by Oklahoma, and in mid-1984, the State received $2.1 million from the Environmental Protection Agency under the Environmental Response, Compensation, and Liability Act of 1980 (Superfund) to cover engineering and construction costs of plugging the wells. An 18-month timeframe was estimated for the entire project, and after several delays, the contract for closing the wells was signed in November and work began.

Eighteen individuals and companies were identified as partially responsible for the Tar Creek pollution and faced possible legal action to reimburse the Federal Government for Superfund expenditures. The companies included Eagle-Picher, Cincinnati, OH; Beck Mining Co. and United American Development Corp., Oklahoma City; Jones & Laughlin Steel Corp., a subsidiary of LTV Corp. of Dallas, TX; St. Joe Minerals; and Azcon Corp. of New York City.

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[1] State Mineral Officer, Bureau of Mines, Denver, CO.

[2] Dikeman, N. J., Jr. Business Highlights. OK Bus. Bull., v. 53, No. 3, Mar. 1985, pp. 1, 5. (Center for Economic & Business Management Research, University of Oklahoma).

[3] U.S. Department of Labor. Employment and Earnings. V. 33, No. 5, May 1984, p. 127.

[4] Al-Shaieh, Z. Molybdenite in the Wichita Mountains, Southwestern Oklahoma. OK Geol. Surv., Oklahoma Geology Notes, v. 44, No. 5, Oct. 1984, pp. 160-164.

[5] Oklahoma Geological Survey. Oklahoma Geology Notes. V. 44, No. 5, Oct. 1984, p. 158.

[6] Hudson, S. Collecting Oklahoma's Barite Roses. Lapidary J., v. 38, No. 11, Feb. 1985, pp. 1468-1470.

[7] Toon, S. Iodine—Tight Supplies, Price To Rise. Ind. Miner. (London), No. 211, Apr. 1985, pp. 63-65.

[8] Michard, D. Quapaw's Versatile Plant Meets Changing Market Needs. Pit & Quarry, v. 77, No. 5, Nov. 1984, pp. 30-33.

[9] ———. Granite Ballast Cuts Railroad Costs. Pit & Quarry, v. 77, No. 6, Dec. 1984, pp. 26-29.

[10] Allen, R. F., and R. G. Thomas. The Uranium Potential of Diagenetically Altered Sandstones of Permian Rush Springs Formation, Cement District, Southwest Oklahoma. Econ. Geol., v. 79, No. 2, Mar.-Apr. 1984, pp. 284-296.

[11] Mining Congress Journal. St. Joe To Buy National Zinc. V. 70, No. 17, Aug. 29, 1984, p. 13.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Blue Circle Inc., a subsidiary of Blue Circle Industries Ltd.[1,2] | 2609 North 145 East Ave.<br>Tulsa, OK 74116 | Quarry and plant | Rogers. |
| Ideal Basic Industries Inc., Ideal Cement Co.[1,2] | Box 8789<br>Denver, CO 80201 | do | Pontotoc. |
| Lone Star Industries Inc.[1,2] | Box 68<br>Pryor, OK 74361 | do | Mayes. |
| Clays: | | | |
| Acme Brick Co., a subsidiary of Justin Industries Inc. | Box 24012<br>Oklahoma City, OK 73124 | Pits and plants | Custer and Oklahoma. |
| Chandler Materials Co | 5805 East 15th St.<br>Tulsa, OK 74102 | do | Oklahoma and Rogers. |
| Commercial Brick Corp | Box 1382<br>Wewoka, OK 74884 | Pit and plant | Seminole. |
| Frankoma Pottery Co | Box 789<br>Sapulpa, OK 74006 | do | Creek. |
| Mangum Brick Co | Box 296<br>Mangum, OK 73554 | do | Greer. |
| Oklahoma Brick Corp., a subsidiary of Merry Companies. | Box 75368<br>Oklahoma City, OK 73147 | do | Canadian. |
| Sapulpa Brick Inc | 704 West Dewey<br>Sapulpa, OK 74006 | Pit | Creek. |
| Feldspar: | | | |
| Arkhola Sand and Gravel Co., a division of APAC-Arkansas Inc.[2,3] | Box 1401<br>Muskogee, OK 74401 | Dredge and plant | Muskogee. |
| Gypsum: | | | |
| Harrison Gypsum Co. Inc | Box 336<br>Lindsay, OK 73052 | Quarry | Caddo. |
| Lehigh Portland Cement Co | Box 1882<br>Allentown, PA 18105 | do | Blaine. |
| Republic Gypsum Co | Drawer C<br>Duke, OK 73532 | Quarry and plant | Jackson. |
| Temple Eastex Inc | Box 101<br>Fletcher, OK 73541 | Quarry | Comanche. |
| United States Gypsum Co | Box 187<br>Southard, OK 73770 | Quarry and plant | Blaine. |
| Western Plains Materials | Box 979<br>Weatherford, OK 73096 | Quarry | Woodward. |
| Iodine: | | | |
| North American Brine Resources | c/o Beard Oil Co.<br>2000 Classen Center Bldg.<br>Oklahoma City, OK 73106 | Oilfield brines and plant. | Kingfisher. |
| Woodward Iodine Corp., a subsidiary of Asahi Glass Co. Ltd. | Box 1245<br>Woodward, OK 73801 | Brine field and plant. | Woodward. |
| Lime: | | | |
| St. Clair Lime Co | Box 569<br>Sallisaw, OK 74955 | Mine and plant | Sequoyah. |
| Pumice (volcanic ash): | | | |
| Axtell Mining Corp | Box 92<br>Gate, OK 73844 | Open pit | Beaver. |
| Salt: | | | |
| Acme Salt Co | Box 420<br>Erick, OK 73645 | Solar evaporation | Harmon. |
| Sand and gravel: | | | |
| Construction: | | | |
| Boorhem-Fields Inc | Box 1177<br>Paris, TX 75460 | Pit and plant | Choctaw. |
| The Dolese Co | Box 677<br>Oklahoma City, OK 73101 | Pits and plants | Canadian, Kingfisher, Logan, Oklahoma. |
| E & A Materials Inc | Box 365<br>Wichita Falls, TX 76307 | Pit and plant | Cotton. |
| Lemon Haskel Construction Co. of General Materials Co. Inc. | Box 24044<br>Oklahoma City, OK 73124 | Pits and plant | Cleveland. |
| McMichael Concrete Co., a subsidiary of Koppers Co. Inc.[2] | Box 3878<br>Tulsa, OK 74102 | Pit and plant | Tulsa. |
| Murphy & Perkins Ready Mix Concrete Co. | Box 82099<br>Oklahoma City, OK 73108 | do | Oklahoma. |
| Shoffner Sand of Oklahoma Inc | Box 863<br>Edmond, OK 73083 | Pits and plant | Do. |
| Industrial: | | | |
| Mid-Continent Glass Sand Co | Box 248<br>Roff, OK 74865 | Pit and plant | Pontotoc. |
| Pennsylvania Glass Sand Corp., Oklahoma Works. | Box 187<br>Berkeley Springs, WV 25411 | do | Johnston. |
| Stone: | | | |
| Crushed: | | | |
| Anchor Stone Co.[3] | 3300 North Mingo Valley Expressway<br>Tulsa, OK 74116 | Quarries and plant | Creek and Tulsa. |
| Dolese Bros. Co | Box 677<br>20 NW 13th St.<br>Oklahoma City, OK 73101 | Quarries | Comanche, Kiowa, Murray, Pittsburg, Seminole, Tulsa. |

See footnotes at end of table.

**Table 5.—Principal producers —Continued**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Stone —Continued | | | |
| Crushed —Continued | | | |
| Hallett Construction Co | Box 13<br>Boone, IA 50036 | Quarry | Murray. |
| Material Producers Inc | Box 577<br>Norman, OK 73070 | do | Do. |
| McNabb Coal Co. Inc | Drawer C<br>Catoosa, OK 74015 | do | Rogers. |
| The Quapaw Co | Box 72<br>Drumright, OK 74030 | do | Creek. |
| Standard Industries, a division of APAC-Oklahoma Inc. | Box 580670<br>Tulsa, OK 74158 | Quarries | Cherokee, Kay, Tulsa. |
| Tulsa Rock Co., a subsidiary of The McMicheal Co. of Koppers Co. Inc. | Box 9486 West 23d St.<br>Tulsa, OK 74107 | Quarry | Rogers. |
| Dimension: | | | |
| Bodie L. Anderson Quarries Inc | Box 106<br>Mill Creek, OK 74856 | do | Johnston. |
| Fairfax Granite Inc., a subsidiary of Rock of Ages Corp. | c/o Rock of Ages Corp.<br>Box 482<br>Barre, VT 05641 | do | Kiowa. |
| Roosevelt Granite Co | Box 307<br>Synder, OK 73566 | Quarries and plant | Do. |
| Tripoli: | | | |
| American Tripoli Co | Box 489<br>Seneca, MO 64865 | Mines | Ottawa. |

[1] Also clays.
[2] Also stone.
[3] Also sand and gravel.

# The Mineral Industry of Oregon

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Oregon Department of Geology and Mineral Industries for collecting information on all nonfuel minerals.**

### By Herbert R. Babitzke[1] and Howard C. Brooks[2]

Oregon's nonfuel mineral production value rose in 1984 to $120 million, an increase of about 9% from the $111 million recorded in 1983. Industrial minerals accounted for nearly all of the nonfuel mineral value reported for the year. Stone was the leading commodity in terms of value, followed by construction sand and gravel, cement, and lime; these commodities accounted for nearly 93% of the total value. Oregon ranked 37th in the Nation in the value of nonfuel mineral production for 1984.

Oregon did not regain prerecession levels of employment in its mineral industry in 1984, but year-over-year gains continued at about 3%. From the standpoint of employment in the industry, i.e., wages and salaries, Oregon's recovery rate was about 50% by yearend.

**Table 1.—Nonfuel mineral production in Oregon[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | 188 | $275 | 189 | $288 |
| Gem stones | NA | 600 | NA | 400 |
| Gold (recoverable content of ores, etc.) troy ounces | 322 | 137 | W | W |
| Nickel (content of ores and concentrates) short tons | -- | -- | 14,540 | W |
| Sand and gravel (construction) thousand short tons | [e]11,000 | [e]37,000 | 12,776 | 37,117 |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 1 | 10 | W | W |
| Stone (crushed) thousand short tons | 13,089 | [r]39,873 | [e]12,500 | [e]37,500 |
| Talc (soapstone) do | (2) | 123 | (2) | 66 |
| Combined value of cement, copper (1983), diatomite, lead (1983), lime, pumice, sand and gravel (industrial, 1983), stone (dimension, 1983), and values indicated by symbol W | XX | 32,922 | XX | 45,031 |
| Total | XX | [r]110,940 | XX | 120,402 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Less than 1/2 unit.

## Table 2.—Value of nonfuel mineral production in Oregon, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Baker | $11,299 | W | Cement, stone (crushed), clays, pumice, silver, copper, lead. |
| Benton | 1,075 | $636 | Stone (crushed). |
| Clackamas | W | W | Cement, stone (crushed). |
| Clatsop | W | 510 | Stone (crushed). |
| Columbia | W | 271 | Do. |
| Coos | W | 1,910 | Do. |
| Crook | W | W | Do. |
| Curry | W | 485 | Do. |
| Deschutes | W | W | Pumice, stone (crushed). |
| Douglas | W | 1,361 | Stone (crushed). |
| Gilliam | W | (2) | |
| Grant | W | W | Stone (crushed). |
| Harney | -- | 258 | Do. |
| Hood River | (3) | 213 | Do. |
| Jackson | 1,628 | W | Talc, stone (crushed). |
| Jefferson | (3) | W | Stone (crushed). |
| Josephine | W | 137 | Gold, silver. |
| Klamath | W | W | Stone (crushed), clays. |
| Lake | W | W | Diatomite, stone (crushed). |
| Lane | 2,905 | 2,279 | Stone (crushed). |
| Lincoln | (3) | 1,616 | Do. |
| Linn | 535 | 118 | Do. |
| Malheur | 1,977 | W | Lime. |
| Marion | 1,653 | W | Stone (crushed). |
| Morrow | W | W | Do. |
| Multnomah | 16,474 | W | Lime, stone (crushed), sand and gravel (industrial), clays. |
| Polk | 122 | 318 | Stone (crushed). |
| Sherman | -- | W | Do. |
| Tillamook | W | 273 | Do. |
| Umatilla | 470 | 1,044 | Do. |
| Union | 143 | (2) | |
| Wallowa | 4 | W | Stone (crushed). |
| Washington | 182 | 6,506 | Do. |
| Yamhill | 305 | 1,872 | Do. |
| Undistributed[4] | [r]27,165 | 54,132 | |
| Sand and gravel (construction) | XX | [e]37,000 | |
| Stone: | | | |
| Crushed | [e]41,900 | XX | |
| Dimension | [r]W | XX | |
| Total[5] | [r]107,840 | 110,940 | |

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[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] Wasco and Wheeler Counties are not listed because no nonfuel mineral production was reported.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[4] Includes some gem stones, stone (crushed), and stone (dimension) that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Oregon business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 2,668 | 2,658 | 2,674 |
| Total civilian labor force | do | 1,324 | 1,341 | 1,336 |
| Unemployment | do | 153 | 145 | 125 |
| Employment (nonagricultural): | | | | |
| Mining total | do | 1.8 | 1.6 | 1.6 |
| Metal mining[1] | do | .2 | .1 | NA |
| Manufacturing total | do | 185.7 | 188.8 | 198.7 |
| Primary metal industries | do | 8.1 | 7.5 | 9.1 |
| Stone, clay, and glass products | do | 3.4 | 3.0 | 2.6 |
| Chemicals and allied products | do | 2.1 | 2.2 | 2.1 |
| Petroleum and coal products | do | .5 | .5 | .5 |
| Construction | do | 28.9 | 27.0 | 29.9 |
| Transportation and public utilities | do | 56.8 | 55.4 | 56.2 |
| Wholesale and retail trade | do | 238.7 | 242.6 | 252.4 |
| Finance, insurance, real estate | do | 64.9 | 64.5 | 65.7 |
| Services | do | 188.6 | 194.6 | 205.0 |
| Government and government enterprises | do | 195.5 | 192.3 | 194.6 |
| Total[2] | do | 961.1 | 966.7 | 1,000.4 |
| Personal income: | | | | |
| Total | millions | $27,100 | $28,545 | $31,052 |
| Per capita | | $10,156 | $10,737 | $11,611 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 37.9 | 38.9 | 39.2 |
| Total average hourly earnings, production workers | | $10.02 | $10.21 | $10.44 |
| Earnings by industry: | | | | |
| Farm income | millions | $471 | $493 | $574 |
| Nonfarm | do | $18,121 | $19,138 | $20,829 |
| Mining total | do | $42 | $38 | $37 |
| Metal mining | do | (3) | $1 | (3) |
| Nonmetallic minerals except fuels | do | W | $24 | $23 |
| Coal mining | do | W | $11 | $11 |
| Oil and gas extraction | do | W | $2 | $4 |
| Manufacturing total | do | $4,449 | $4,716 | $5,211 |
| Primary metal industries | do | $264 | $253 | $305 |
| Stone, clay, and glass products | do | $85 | $81 | $79 |
| Chemicals and allied products | do | $43 | $48 | $49 |
| Petroleum and coal products | do | W | $17 | $17 |
| Construction | do | $812 | $801 | $909 |
| Transportation and public utilities | do | $1,568 | $1,625 | $1,725 |
| Wholesale and retail trade | do | $3,478 | $3,656 | $3,983 |
| Finance, insurance, real estate | do | $942 | $1,025 | $1,096 |
| Services | do | $3,328 | $3,599 | $4,011 |
| Government and government enterprises | do | $3,376 | $3,534 | $3,701 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 7,720 | 8,694 | 8,036 |
| Value of nonresidential construction | millions | $484.1 | $439.0 | $525.9 |
| Value of State road contract awards | do | $172.4 | $226.8 | $217.1 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 574 | 554 | 609 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $107.8 | $110.9 | $120.4 |
| Value per capita | | $40 | $42 | $45 |

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[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[2] Data may not add to totals shown because of independent rounding.

[3] Less than 1/2 unit.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

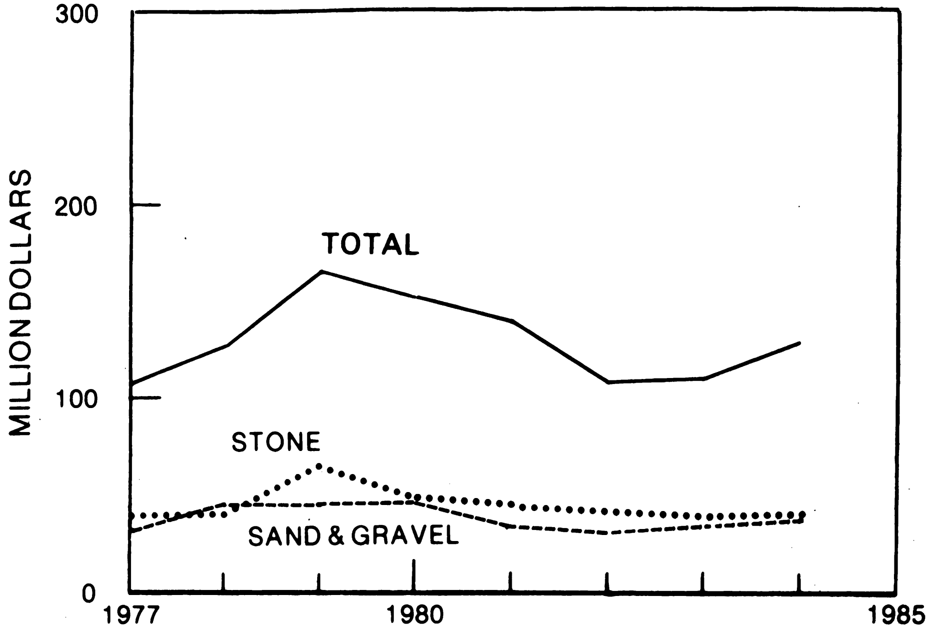

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Oregon.

**Trends and Developments.**—The Hanna Mining Co. produced about 1 million pounds of nickel per month at its integrated mine and smelter complex near Riddle. The operation, the sole domestic nickel producer, resumed production in late 1983, following an 18-month shutdown. Aluminum companies curtailed production during the year. Reynolds Metals Co. idled two potlines at its Troutdale smelter in July, reducing production by 38% to 80,000 short tons of metal per year. Martin Marietta Aluminum Inc. reduced its operating rate at The Dalles reduction plant to one-half capacity in June and announced a complete shutdown of the plant by yearend. Both companies blamed the reduction on faltering aluminum prices and higher power rates. In addition, Alumax Inc. abandoned plans to build a $660 million, 220,000-ton-per-year-capacity aluminum smelter near Umatilla.

Titanium markets improved in 1984, and production increased at Oregon Metallurgical Corp. in Albany, the Nation's third largest producer. Albany Titanium Inc. (AL-Ti) was building two pilot plants to test a new process that would produce titanium sponge from domestic ilmenite.

Eagle-Picher Industries Inc. announced plans to build a $13 million diatomite plant 7 miles west of Vale in eastern Oregon's Malheur County. The diatomite would be mined from deposits on public and private lands near the Malheur-Harney County line. The Eagle-Picher plant would be the second in the State producing diatomite. The other, in Lake County, was not expected to be in competition because end-use destinations are dissimilar. Oregon Portland Cement Co., a wholly owned subsidiary of Ash Grove Cement Co., was redesignated as Ash Grove Cement West Inc. in July. Ash Grove is the largest cement producer in the Northwest.

**Exploration Activities.**—Most metallic mineral exploration projects in 1984 were for gold and silver. Exploration efforts were concentrated in the northeastern and southwestern parts of the State, where most of Oregon's productive precious metals mines have been situated. Several major companies, however, continued to explore parts of southeastern Oregon for gold deposits.

American Copper & Nickel Co. Inc. continued exploration programs in the Susanville District, the Sunrise Butte area, and the Bald Mountain-Ibex Mines area.

The Susanville District is a small area in

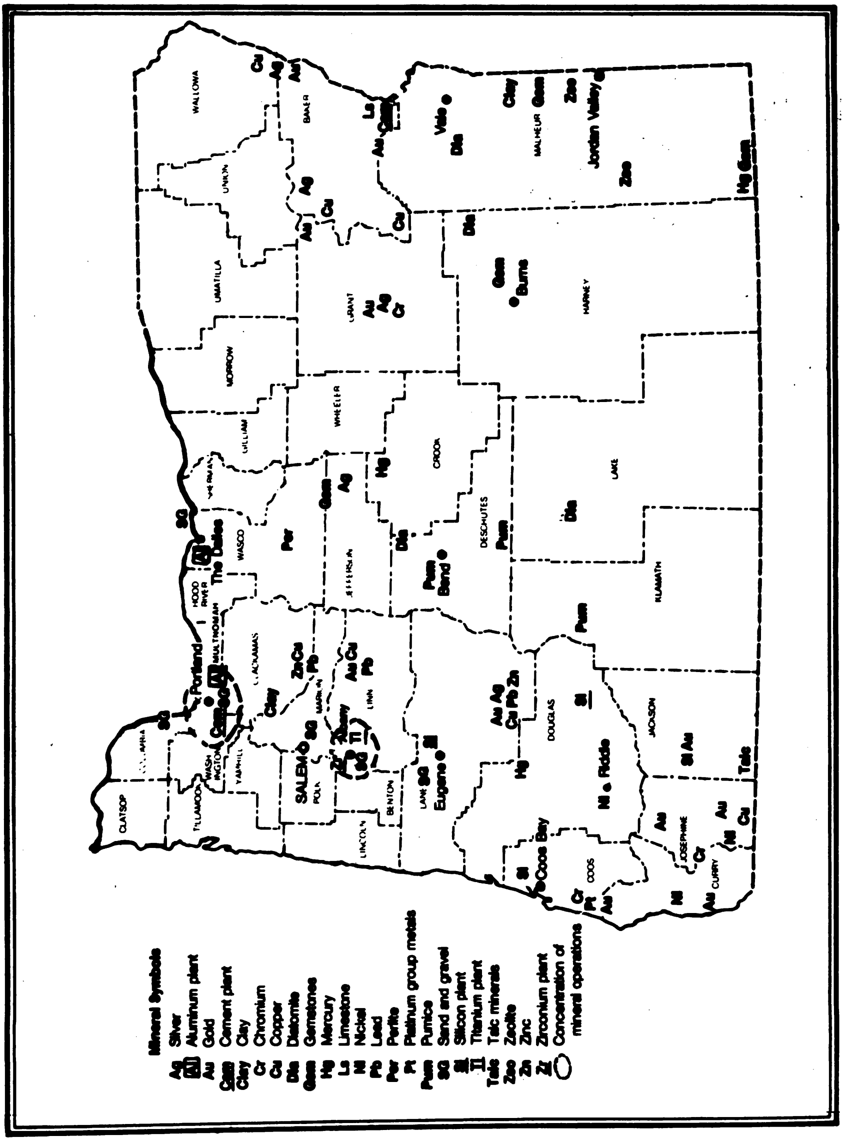

Figure 2.—Principal mineral producing localities in Oregon.

Grant County in the western part of the Blue Mountains gold belt. District gold output was mainly from placers. American Copper & Nickel began its exploration program in the district in 1980. Target areas include parts of the old Badger, Bull of the Woods, and Gem lode gold mines. Work included rehabilitation of some underground workings, surface trenching, and drilling. About 6,000 feet of diamond drilling was done during the summer.

Sunrise Butte is in the western part of the Greenhorn District, also in Grant County. Old mines in the vicinity include the Ben Harrison, Morris, and Tiger. Work by American Copper & Nickel included surface sampling, mapping, geophysics, and drilling. About 2,000 feet of drilling was done in 1984.

Bald Mountain and Ibex Mines are adjoining properties in Grant and Baker Counties in the Cracker Creek mining district, about 5 miles northwest of Sumpter. These old properties produced small amounts of gold at various times in the past and were acquired by NERCO Minerals Co. in mid-1980. Ibex Mining Co. was formed as the operating company. During 1981 and through 1983, 3,200 feet of old workings was reopened, and 54,000 feet of exploration diamond drilling and 2,000 feet of new underground work were done. In 1984, American Copper & Nickel joined the venture and became the operating partner. The company surface drilled about 12,700 feet (33 holes) during the summer. An underground exploration program was being considered for 1985.

M and S Associates did some exploration and development work at the Friday and Hidden Treasure Mines in the Virtue gold mining district, about 8 miles east of Baker. Work accomplished by M and S included some large dozer cuts and the construction of a small vat-type cyanidation plant.

The Sunday Hill Mine, in the northern part of the Mormon Basin mining district in Malheur County, was acquired in 1983 by Capri Resources Ltd. of Vancouver, British Columbia, Canada. Seven diamond drill holes were drilled in 1984; additional work was planned.

In 1984, Manville Products Corp. acquired the old Record gold mine at the northwestern end of the Grouse Spring property in Baker County. The Record Mine produced about $100,000 in gold prior to World War II from narrow quartz veins along the contact between quartz diorite and serpentinite. Reevaluation of the property was started and was to be continued in 1985.

Exploration in the Keating area of Baker County included work in the vicinity of the old Mother Lode Mine. This property produced about 1 million pounds of copper and 8,000 troy ounces of gold in the late 1930's. Some drilling was done in 1983 and 1984.

Work continued on a massive sulfide deposit in the McCullogh Creek area near Glendale in southern Douglas County. Exploration was started by Exxon Minerals Co. in 1978. Boise Cascade Corp. entered into a joint venture on the project in 1984. Some diamond drilling, soil geochemistry, and geophysical work was done. Boise Cascade also did some exploration work at the old Gold Note Mine on the Josephine-Jackson County line.

Mega Gold Resources Ltd. continued its evaluation of the Greenback gold mine in Josephine County near the head of Tom East Creek, 1-1/2 miles north of the old settlement of Placer. The main vein, with a length of more than 500 feet, averages 20 inches in width and terminates in a fault to the west and against serpentinite to the east. Gold was 75% free milling. Geologic mapping by Mega Gold indicated 18 parallel quartz veins in a 4,500-foot-long band of greenstone.

Wesley Pieren and Associates was doing development work at the old Sugar Pine gold mine west of Galice in Josephine County, where about 3,000 feet of old workings was explored. Old adits were opened and sampled, and a new lower level adit was started.

Ray Rock Mines Inc. continued exploration at the Turner Albright Mine near the California border of southern Josephine County. Considerable exploration work has been done in recent years, including work by Beretta in 1980 and 1981 and by Noranda Exploration Inc. in 1982 and 1983. Noranda reported reserves of 3.3 million short tons averaging 0.114 troy ounce of gold per ton, 0.443 ounce of silver per ton, 1.46% copper, 3.32% zinc, and 0.055% cobalt. Ray Rock acquired the property in 1983 and has reportedly increased the reserves reported by Noranda.

Exploration continued in the vicinity of the old Axehandle and Red Jacket mercury mines, now called the Rejax Prospect, in Jefferson County. Over the years, total mercury output was about 150 flasks. Ocelot Industries Ltd. prospected epithermal gold occurrences in the area for several years and was joined by Meridian Land and Minerals Co. in 1984. Some drilling was done during the 1984 field season.

Major mining companies active in east central Oregon during recent years are Manville, Freeport Exploration Co., Homestake Mining Co., and Meridian. The Birch Creek, Vale Butte, and Red Butte properties are owned by Manville. Some drilling was done at Birch Creek and Vale Butte by Meridian in 1984.

The Anaconda Minerals Co. continued prospect drilling in the Quartz Mountain area of Malheur County in 1984. Drilling began in 1983 and plans were to continue in 1985. Anaconda land holdings in the area total about 5 square miles. For many years, the Quartz Mountain District has been known to contain small mercury deposits of the opalite type.

Noranda continued to surface diamond drill in the Idol City area in Harney County, north of Burns. The exploration target was a zone of gold-silver mineralization. The area had previously been placer mined on a small scale.

**Legislation and Government Programs.**—The Oregon Wilderness Bill became law when legislation approved May 24, 1984, by the U.S. Senate was signed by the President. This action put another 935,000 Oregon acres into Federal wilderness status; Oregon now has 2.1 million acres in wilderness.

The Governor of Oregon and the Secretary of the Interior formed a joint Federal-State working group in February to consider the economic, engineering, and environmental aspects of possible ocean mining of polymetallic sulfide resources from the Gorda Ridge, and to share in the scoping and preparation of an environmental impact statement to assess the development potential of these resources. Both the Governor and the Secretary agreed to reduce the proposed Gorda Ridge lease offering within the 200-mile Exclusive Economic Zone off the Oregon coast from 40 million offshore acres to not more than 4 million acres. At the same time, a joint Federal-State working group was formed to carry out the mandate. The agreement also eliminated from the lease offering the near-shore sections of the original proposed area. The Gorda Ridge is a large underwater range seaward of the Continental Shelf thought to contain deposits of polymetallic sulfides.

Strategic minerals potentially worth billions of dollars may be present in a vast undersea area off the Oregon coast. The 70,000-square-mile area is in the new Exclusive Economic Zone and is between 30 and 200 miles offshore, extending from Lincoln City south beyond Eureka, CA. Sampling on sections of the Gorda Ridge by the U.S. Minerals Management Service produced results indicating the presence of large quantities of copper, iron, and zinc, and lesser quantities of other strategically important metals.

Mineral leasing payments to Oregon by the U.S. Bureau of Land Management totaled $1.65 million.

To date, over 1,400 acres of mined land in Oregon has been reclaimed to agriculture, forestry, housing, industry, recreation, wildlife habitat, and other uses. The 1984 Award for the Outstanding Mined Land Reclamation Project went to two nominees—the Oregon State Highway Division (OSHD) and Portland General Electric Co. (PGE). PGE was honored for the reclamation of its proposed Pebble Springs nuclear site in Gilliam County. The site was returned to productive grazing land. OSHD reclaimed approximately 16 acres of a basalt quarry on Rattlesnake Butte, south of Cottage Grove, Lane County.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

The value of industrial mineral production in Oregon increased 4% over that recorded for 1983.

There were 422 sites under permit in 1984 under the Surface Mined Land Reclamation Program, most of which were for industrial minerals (primarily sand and gravel and stone).

**Cement.**—Cement production in the State for 1984 increased 7% over that reported in 1983; Ash Grove Cement West Inc. (formerly Oregon Portland Cement Co.) was the sole producer. Ash Grove operated its limestone quarry and cement plant near Durkee, Baker County, throughout the year. Oregon Portland began operating the Durkee quarry in 1959, and until 1981, produced limestone for its cement plants at Lime and Lake Oswego. In 1980, a new plant was built at the Durkee site, and the clinker producing facilities at Lime and Lake Oswego were phased out. The plant at Lime is now used only for bagging, and the Lake Oswego plant is used as a distribution facility. The Durkee plant has an annual capacity of 500,000 short tons of cement and employs about 100 people year-round. Company management indicated that current orders for cement would require near-capacity production through 1985.

Portland cement produced in 1984 was used as follows: 73% by ready-mixed concrete companies, 13% by highway contractors, 7% by concrete products manufacturers, and 7% by building material dealers and others. Raw materials used to produce cement were clays, gypsum, iron ore, limestone, and shale.

**Clays.**—Common clays, used chiefly in brick and cement, were produced in Baker, Klamath, and Multnomah Counties. Both quantity and value increased slightly over those in 1983. At Adrian, in Malheur County, Teague Mineral Products Co. continued to produce bentonitic clay and zeolite for various uses. Bentonite production was at the rate of about 12,000 short tons per year; about 10,000 tons of zeolite was produced in 1984. The bentonite and zeolite were mined from deposits in the Sucker Creek area; the grinding, drying, and bagging plant is in Adrian. Teague reported that development of a new bentonite deposit 20 to 25 feet thick with a dip of 19° was begun in 1984. A total of 12,000 feet of drilling was done on the deposit during the year.

**Diatomite.**—In January, Eagle-Picher announced plans to invest $13 million in a diatomite mine and treatment facilities in Malheur and Harney Counties. The plantsite is 7 miles west of Vale, and the minesite is near Drewsey, 65 miles further to the west. Production was expected to be from 140,000 to 150,000 bank cubic yards of diatomite ore per year. Mill waste at 30,000 to 33,000 cubic yards per year would be backhauled to the minesite for final disposal. The company has obtained conditional mine-use permits on 3,700 acres, and long-term mining plans call for development on private, State, and Federal lands over the next 15 to 20 years. The operation would employ 30 to 35 people. Construction of the plant began in the fall of 1984 and was expected to be completed in mid-1986.

Oil-Dri Production Co. continued to produce diatomite at its quarry and plant in Christmas Valley. Most of the product was used for cat litter and as an oil absorbent; some was used as an anticaking additive in animal feeds and as a carrier for hazardous wastes. Mining, processing, packaging, shipping, and marketing of the diatomite was handled by Oil-Dri. Between 30 and 35 people were employed year-round. Retailing was done through food and drug chains in 11 Western States and in western Canada.

**Lime.**—Lime production in Oregon for 1984 increased 11% in volume and 12% in value over that reported in 1983. Ash Grove in Multnomah County and Amalgamated Sugar Co. in Malheur County continued lime production throughout the year. Most of the lime produced was quicklime; some hydrated lime was produced by Ash Grove. The Ash Grove lime was used by the pulp and paper and electric steel industries, while that produced by Amalgamated Sugar was used in the company's own sugar refinery. The hydrated lime was used primarily for oil and grease treatment, road stabilization, and animal feed.

**Peat.**—Clatsop Peat Co. was formed to mine and market peat from a 5- to 12-foot-thick deposit 1-1/2 miles northeast of Gearhart, Clatsop County. Approximately 8 acres of cleared, nearly flat land is available for mining. Excavation was to be done with floating equipment.

**Pumice.**—Oregon ranked first in the Nation for pumice production in 1984. The quantity of pumice produced in the State increased slightly over the 1983 production level, but the value was up more than 10% over that reported in 1983. Pumice was produced by Central Oregon Pumice Co. and Cascade Pumice Co./Graystone Corp. from two pits in the Bend area, Deschutes County. Primary uses were for concrete aggregate (52%), decorative building block (38%), road construction and maintenance (5%), and landscaping and roofing (5%).

**Sand and Gravel (Construction).**—Construction sand and gravel is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Oregon's 1984 output of construction sand and gravel increased more than 34% in quantity and 21% in value over that reported for 1982, when the last complete canvass was taken. Construction sand and gravel was produced from 198 operations by 83 companies in 27 counties. Six companies and one Government agency produced 50% of the State's construction sand and gravel in 1984; the leading 22 producers accounted for 80% of the total. The product was transported by truck (86%), waterway (1%), and by other means (4%), and 9% was used onsite. Uses of construction sand and gravel are shown in table 4.

### Table 4.—Oregon: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 1,738 | $5,773 | $3.32 |
| Plaster and gunite sands | W | W | 7.81 |
| Concrete products | W | W | 3.90 |
| Asphaltic concrete | 950 | 3,133 | 3.30 |
| Road base and coverings[1] | 2,354 | 7,319 | 3.11 |
| Fill | 503 | 1,099 | 2.18 |
| Snow and ice control | 40 | 121 | 3.01 |
| Other[2] | 7,191 | 19,673 | 2.74 |
| Total or average | 12,776 | [3]37,117 | 2.91 |

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1] Includes road and other stabilization (cement).
[2] Includes other unspecified uses and uses indicated by symbol W.
[3] Data do not add total shown because of independent rounding.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

The Quartz Mountain silica mine in eastern Douglas County supplied metallurgical-grade silica for use in the reduction of nickel ore to ferronickel at the Hanna Mining smelter near Riddle. About 7,300 short tons of silica was mined from Quartz Mountain during the year, and silica was also shipped from a stockpile of previously mined material.

Bristol Silica and Limestone Co.'s mine near Gold Hill produced about 24,000 tons of dolomite, limestone, shale, and silica during 1984. Most of the silica was marketed at the Dow Corning Chemical Co. metallurgical plant in Springfield.

Genstar Stone Products Co. optioned the Jones marble deposit west of Williams in Josephine County to test the quality and quantity of white marble for possible use in making paper. Work on a drilling program was accomplished in 1984.

**Talc (Soapstone).**—Steatite of Southern Oregon Inc.'s rate of production of soapstone for art carving and other specialty uses was slightly lower than in previous years. The mine is on Elliott Ridge, southeast of the new Applegate Reservoir in Jackson County, and the plant is in Grants Pass, Josephine County. The high-quality soapstone product was marketed on a worldwide basis.

## METALS

**Aluminum.**—Aluminum production in the State increased nearly 18% in quantity and 34% in value over that of 1983. Riding on a continuation of the economic recovery that began in mid-1983, Oregon's aluminum smelters were operating at full capacity at the start of 1984. A worldwide aluminum oversupply, however, led to a 68% drop in aluminum prices by midyear. This factor, together with increased power rates, led first to layoffs and finally to a permanent shutdown at one smelter. Martin Marietta Aluminum laid off 175 workers in June at its reduction plant in The Dalles and reduced the operating rate to 50% of capacity. In December, the company proceeded to a total shutdown and the permanent layoff of the remaining 240 workers. The company rebuffed bids by private investors and employees to purchase the smelter and refused to delay closing of the plant to allow time for a feasibility study preparatory to a buy out.

Reynolds Metals shut down 2 potlines at its Troutdale smelter in July, reducing its output by 50,000 short tons of metal per year and idling 225 of the plant's 950 workers.

Alumax abandoned plans to build a $660 million aluminum smelter near Umatilla.

**Columbium, Tantalum, Zirconium, Hafnium, and Vanadium.**—Teledyne Wah Chang Albany (TWCA) was listed among eight major domestic processors and/or producers of columbium and tantalum in 1984. The company, which employs 1,300 people at its Albany plant, has facilities to produce columbium and tantalum metal, columbium pentoxide, and ferrocolumbium. Overall reported domestic consumption of columbium in steels and superalloys was up in 1984, and tantalum consumption continued to rise, as reflected in the 26% increase in overall shipments reported by the Tantalum Producers Association. TWCA continued to be the Nation's leading producer of zirconium and hafnium, metals used in manufacturing nuclear fuel rods; the two metals accounted for 70% of the company's production. The company provided metal for fuel rods for 80 operating nuclear plants, for 60 plants under construction, and for nuclear-powered Navy ships. TWCA also produced high-purity vanadium metal for vanadium-gallium superconductors and for other applications in the aerospace, electronic, and nuclear industries.

**Gold, Silver, Copper, and Lead.**—A number of small gold placers were active in Baker and Grant Counties, northeastern Oregon, and in Josephine and Douglas Counties, southwestern Oregon. Few produced more than 50 troy ounces of gold, and most probably produced less than 10 ounces. The most productive placer operations in eastern Oregon were on Pine Creek near Hereford and on Clarks Creek near Bridgeport, both in Baker County. Numerous small placer operations continued active in Josephine County, including several on Josephine Creek and its tributaries, Canyon Creek and Fiddler Gulch. Sucker Creek continued to be worked in several places. There were also operations on Democrat Gulch and Althouse Creek. The semicemented outwash gravels of Democrat Gulch near Holland were worked by shafts and drift mining along bedrock. There were also several placer operations in the Galice area and along Galice Creek, Rocky Gulch, Taylor Creek, and the Old Channel Mine. In Douglas County, some placer activity continued along Cow Creek and its tributaries. One operation on Coffee Creek northwest of Tiller has been active for 4 years.

Lode gold and silver and base metals production was mainly from the Iron Dyke, Bay Horse, and Thomason Mines in Baker County and the Pyx Mine in Grant County, each of which was operated only part of the year.

The Iron Dyke and Bay Horse Mines were each operated by Silver King Mines Inc. for about 6 months during 1984. Both mines were closed near the end of August. The ore was trucked to Silver King's mill at the company's Copper Cliff Mine near Cuprum, ID. The mill was closed after treatment of the ore was completed.

Company reports to the State of Oregon indicate 1984 production at the Iron Dyke was about 6,000 short tons averaging 0.26 ounce of gold, 1.4 ounces of silver, and 2.3% copper per ton. Reserves were reported as about 20,000 tons averaging 0.3 ounce of gold and 3% copper per ton. No exploration or development occurred at the Iron Dyke in 1984.

Silver King's work at the Bay Horse Mine began in 1984 under a lease agreement naming Silver King and Western Lands and Resources as partners and Silver King as the operator. The property is owned by Ibex Minerals Inc., who acquired it in 1977. Production reported to the State in 1984 was about 6,000 tons averaging 12 ounces of silver per ton. Ibex reported reserves of about 20,000 tons averaging about 15 ounces of silver per ton, and believes the chances are excellent that reserves can be expanded significantly. About 1,000 feet of underground work and 15,000 feet of drilling were done at Bay Horse in 1984.

**Nickel.**—The Hanna Mining nickel mine and smelter at Nickel Mountain, near Riddle in Douglas County, were reopened in December 1983 after an 18-month shutdown. The facilities operated throughout 1984 on a part-time basis. The smelter used electrical power purchased at a special contract rate during prescribed offpeak demand periods. Despite operating with a favorable labor contract and special power rates, the company experienced a monetary loss because the price of nickel did not firm up as expected. Some of the loss was temporarily offset by the use of higher grade ore for smelter feed. The high-grade ore, which is about 2% nickel, occurs in limited quantities, however, and cannot be produced for an extended period. Various methods of upgrading mine-run ore, including the installation of a wet screening process, were being considered. In 1984, 1,211,700 short tons of ore was screened and processed, and 29,080,000 pounds of nickel was used or shipped in the form of ferronickel. Ore trammed to the smelter averaged 1.20% nickel.

**Titanium.**—ALTi was constructing two pilot plants in Albany to develop a newly patented process for production of titanium powder and sponge from domestic ilmenite. Funding for the project came partly from a $4 million Department of Defense grant. The new process, licensed by Occidental Petroleum Corp., was reported to be considerably different and lower cost than the conventional Kroll method. The Defense Department grant provided the financial impetus required by ALTi to activate company plans.

In December, Oregon Metallurgical in Albany raised its operating rate from 65% to 85% of its 9-million-pound-per-year sponge capacity.

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[1] State Mineral Officer, Bureau of Mines, Spokane, WA.

[2] Resident geologist, Oregon Department of Geology and Mineral Industries, Baker Field Office, Baker, OR.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum: | | | |
| Martin Marietta Aluminum Inc | 3313 West Second St.<br>The Dalles, OR 97058 | Smelter | Wasco. |
| Reynolds Metals Co | 5100 NE. Sundial Rd.<br>Troutdale, OR 97060 | do | Multnomah. |
| Cement: | | | |
| Ash Grove Cement West Inc.[1] | 111 SE. Madison St.<br>Portland, OR 97214 | Plants and quarries. | Baker. |
| Diatomite: | | | |
| Oil-Dri Production Co | Box 191<br>Christmas Valley, OR 97638 | Surface mine and plant. | Lake. |
| Lime: | | | |
| Amalgamated Sugar Co | Box 1766<br>Nyssa, OR 97913 | Plant | Malheur. |
| Ash Grove Cement Co | 8900 Indian Creek Pkwy.<br>Suite 600<br>Overland Park, KS 66225 | do | Multnomah. |
| Nickel: | | | |
| The Hanna Mining Co | Box 85<br>Riddle, OR 97469 | Surface mine and smelter. | Douglas. |
| Sand and gravel (construction): | | | |
| Afab Inc. (Empco Co. Inc.) | 21800 NE. Glisan St.<br>Fairview, OR 97024 | Pit and plant | Multnomah. |
| Cascade Aggregates Inc | Box 1225<br>Scappoose, OR 97056 | do | Columbia. |
| River Bend Sand & Gravel Co | Box 12095<br>4420 Turner Rd. SE.<br>Salem, OR 97309 | Pit | Marion. |
| Ross Island Sand & Gravel Co | 4129 SE. McLoughlin Blvd.<br>Portland, OR 97202 | Pit and plant | Multnomah. |
| U.S. Forest Service, Region 6 | 319 SW. Pine St.<br>Portland, OR 97208 | Pits | Various. |
| Western Pacific Construction Materials Co. | 3510 SW. Bond Ave.<br>Portland, OR 97201 | Pit and plant | Multnomah. |
| Talc (soapstone): | | | |
| Steatite of Southern Oregon Inc | 2891 Elk Lane<br>Grants Pass, OR 97526 | Surface mine and mill. | Jackson and Josephine. |
| Titanium: | | | |
| Oregon Metallurgical Corp | Box 580<br>Albany, OR 97321 | Smelter | Linn. |
| Zirconium: | | | |
| Teledyne Wah Chang Albany[2] | 1600 NE. Old Salem Rd.<br>Albany, OR 97321 | do | Do. |

[1] Also clays, pumicite, and crushed stone.

[2] Also columbium, hafnium, tantalum, and vanadium.

# The Mineral Industry of Pennsylvania

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, for collecting information on all nonfuel minerals.**

**By L. J. Prosser, Jr.,[1] Arthur A. Socolow,[2] and S. W. Berkheiser, Jr.[3]**

The value of nonfuel mineral production in Pennsylvania was $708.4 million in 1984, the highest total since the $721.7 million in 1979. Pennsylvania continued as a leading domestic producer of cement, lime, and crushed stone. About 8% of the Nation's cement, 10% of the lime, and 6% of the crushed stone was produced in the State in 1984. These commodities accounted for over four-fifths of the State's total value of mineral production.

The State's iron and steel industry recorded a slight increase in production in 1984 but remained depressed in comparison to the late 1970's. United States Steel Corp. (USS) and Bethlehem Steel Corp., in a joint effort, were awarded a $29 million research contract aimed at developing state-of-the-art technology in casting steel.

The Pennsylvania Wilderness Act was signed into law, creating the State's first wilderness area in the 750,000-acre Allegheny National Forest.

**Table 1.—Nonfuel mineral production in Pennsylvania[1]**

| Mineral | | 1983 | | 1984 | |
|---|---|---|---|---|---|
| | | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Cement: | | | | | |
| Masonry | thousand short tons | 262 | $17,095 | 298 | $20,849 |
| Portland | do | 5,154 | 218,539 | 5,735 | 281,590 |
| Clays[2] | do | 916 | 4,311 | 963 | 4,050 |
| Gem stones | | NA | 5 | NA | 5 |
| Lime | thousand short tons | 1,507 | 81,682 | 1,620 | 90,182 |
| Peat | do | 22 | 628 | 24 | 693 |
| Sand and gravel (construction) | do | [e]11,800 | [e]52,000 | 14,472 | 64,285 |
| Stone: | | | | | |
| Crushed | do | 51,523 | 226,948 | [e]56,200 | [e]228,000 |
| Dimension | do | 53 | 5,799 | [e]44 | [e]6,001 |
| Zinc (recoverable content of ores, etc.) | metric tons | 16,792 | 15,322 | -- | -- |
| Combined value of clays (kaolin), mica (scrap), and sand and gravel (industrial) | | XX | 12,812 | XX | 12,701 |
| Total | | XX | 635,141 | XX | 708,356 |

[e] Estimated. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes kaolin; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Pennsylvania, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adams | $9,747 | W | Stone (crushed), lime, clays, mica. |
| Allegheny | 17,377 | W | Cement, stone (crushed), clays, sand (industrial). |
| Armstrong | W | $2,133 | Stone (crushed), clays. |
| Beaver | 9,189 | W | Clays. |
| Bedford | (2) | W | Stone (crushed). |
| Berks | W | W | Cement, stone (crushed), clays. |
| Blair | (2) | 11,496 | Stone (crushed). |
| Bradford | 921 | (3) | |
| Bucks | W | 13,433 | Stone (crushed), stone (dimension), clays. |
| Butler | 17,140 | W | Lime, cement, stone (crushed). |
| Cameron | W | (3) | |
| Carbon | 912 | (3) | |
| Centre | 18,672 | 34,290 | Lime, stone (crushed). |
| Chester | W | W | Stone (crushed), lime, stone (dimension), clays. |
| Clearfield | W | 154 | Clays. |
| Clinton | 536 | 657 | Stone (crushed), clays. |
| Columbia | W | W | Stone (crushed). |
| Crawford | 1,094 | (3) | |
| Cumberland | 923 | 4,189 | Stone (crushed). |
| Dauphin | W | 4,388 | Do. |
| Delaware | (2) | W | Stone (crushed), stone (dimension). |
| Elk | (2) | W | Stone (crushed). |
| Erie | 4,096 | 59 | Peat. |
| Fayette | -- | 8,832 | Stone (crushed). |
| Forest | W | W | Do. |
| Franklin | W | W | Do. |
| Fulton | W | W | Do. |
| Huntingdon | W | W | Sand (industrial), stone (crushed). |
| Jefferson | W | W | Clays, stone (crushed). |
| Juniata | (2) | W | Stone (crushed). |
| Lackawanna | W | 1,097 | Stone (crushed), peat. |
| Lancaster | 973 | W | Stone (crushed), clays. |
| Lawrence | 24,418 | W | Cement, stone (crushed), clays, peat. |
| Lebanon | W | W | Lime, stone (crushed). |
| Lehigh | W | W | Cement, zinc, stone (crushed), stone (dimension). |
| Luzerne | W | W | Stone (crushed), peat. |
| Lycoming | W | W | Stone (crushed). |
| McKean | W | 92 | Do. |
| Mercer | 2,106 | W | Do. |
| Mifflin | W | W | Stone (crushed), lime. |
| Monroe | 1,115 | W | Stone (crushed), clays, peat. |
| Montgomery | W | 22,355 | Stone (crushed), lime, stone (dimension). |
| Montour | (2) | W | Stone (crushed). |
| Northampton | 113,301 | 128,368 | Cement, stone (crushed), stone (dimension). |
| Northumberland | 907 | W | Stone (crushed), clays. |
| Perry | (2) | W | Stone (crushed). |
| Pike | 101 | W | Do. |
| Potter | (2) | -- | |
| Schuylkill | W | 919 | Do. |
| Snyder | (2) | W | Do. |
| Somerset | 1,778 | W | Stone (crushed), clays. |
| Susquehanna | W | W | Stone (crushed), stone (dimension). |
| Tioga | W | W | Stone (crushed). |
| Union | 65 | W | Stone (crushed), clays. |
| Venango | W | W | Stone (crushed), sand (industrial). |
| Warren | 2,499 | (3) | |
| Wayne | W | W | Stone (crushed), stone (dimension). |
| Westmoreland | W | 10,005 | Stone (crushed). |
| Wyoming | W | 1 | Stone (dimension). |
| York | 14,604 | 46,214 | Stone (crushed), lime, cement, clays. |
| Undistributed[4] | 152,924 | 294,458 | |
| Sand and gravel (construction) | XX | [e]52,000 | |
| Stone: | | | |
| Crushed | [e]200,900 | XX | |
| Dimension | [r] [e]5,033 | XX | |
| Total[5] | [r]601,329 | 635,141 | |

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[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Pennsylvania business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 11,879 | 11,889 | 11,901 |
| Total civilian labor force | do | 5,487 | 5,506 | 5,487 |
| Unemployment | do | 599 | 650 | 499 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 45.7 | 39.0 | 38.7 |
| Metal mining[2] | do | .2 | .2 | NA |
| Nonmetallic minerals except fuels | do | 4.2 | 3.9 | 4.0 |
| Coal mining | do | 35.8 | 30.1 | 29.3 |
| Oil and gas extraction[2] | do | 5.4 | 4.8 | NA |
| Manufacturing total | do | 1,170.5 | 1,095.8 | 1,119.8 |
| Primary metal industries | do | 143.3 | 120.4 | 118.3 |
| Stone, clay, and glass products | do | 51.4 | 48.7 | 48.9 |
| Chemicals and allied products | do | 59.2 | 58.1 | 58.7 |
| Petroleum and coal products | do | 16.4 | 14.8 | 12.8 |
| Construction | do | 168.1 | 165.7 | 175.7 |
| Transportation and public utilities | do | 249.0 | 239.7 | 246.3 |
| Wholesale and retail trade | do | 978.8 | 994.1 | 1,032.8 |
| Finance, insurance, real estate | do | 239.6 | 243.0 | 253.5 |
| Services | do | 1,046.0 | 1,073.2 | 1,108.3 |
| Government and government enterprises | do | 682.5 | 673.7 | 672.0 |
| Total[3] | do | 4,580.1 | 4,524.3 | 4,647.0 |
| Personal income: | | | | |
| Total | millions | $129,772 | $136,023 | $146,545 |
| Per capita | | $10,925 | $11,441 | $12,314 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.4 | 39.2 | 40.2 |
| Mining (nonmetallic minerals, except fuels) | | 42.5 | 43.4 | 44.6 |
| Total average hourly earnings, production workers | | $8.63 | $8.95 | $9.28 |
| Mining (nonmetallic minerals, except fuels) | | $8.81 | $8.99 | $9.34 |
| Earnings by industry: | | | | |
| Farm income | millions | $723 | $636 | $944 |
| Nonfarm | do | $88,552 | $92,665 | $100,485 |
| Mining total | do | $1,495 | $1,262 | $1,378 |
| Metal mining | do | $4 | $5 | (4) |
| Nonmetallic minerals except fuels | do | $88 | $87 | $91 |
| Coal mining | do | $1,182 | W | W |
| Oil and gas extraction | do | $221 | W | W |
| Manufacturing total | do | $27,702 | $27,208 | $29,391 |
| Primary metal industries | do | $4,683 | $4,025 | $4,162 |
| Stone, clay, and glass products | do | $1,275 | $1,284 | $1,358 |
| Chemicals and allied products | do | $1,746 | $1,861 | $1,999 |
| Petroleum and coal products | do | $747 | $725 | $716 |
| Construction | do | $4,284 | $4,561 | $4,976 |
| Transportation and public utilities | do | $6,863 | $7,146 | $7,581 |
| Wholesale and retail trade | do | $13,303 | $14,148 | $15,404 |
| Finance, insurance, real estate | do | $4,691 | $5,319 | $5,876 |
| Services | do | $17,732 | $19,741 | $21,885 |
| Government and government enterprises | do | $12,254 | $13,039 | $13,729 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 22,271 | 33,508 | 36,770 |
| Value of nonresidential construction | millions | $1,560.2 | $1,744.3 | $1,955.3 |
| Value of State road contract awards | do | $275.0 | $298.0 | $94.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 2,310 | 2,417 | 2,686 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $601.3 | $635.1 | $708.4 |
| Value per capita | | $51 | $53 | $60 |

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

[4] Less than 1/2 unit.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

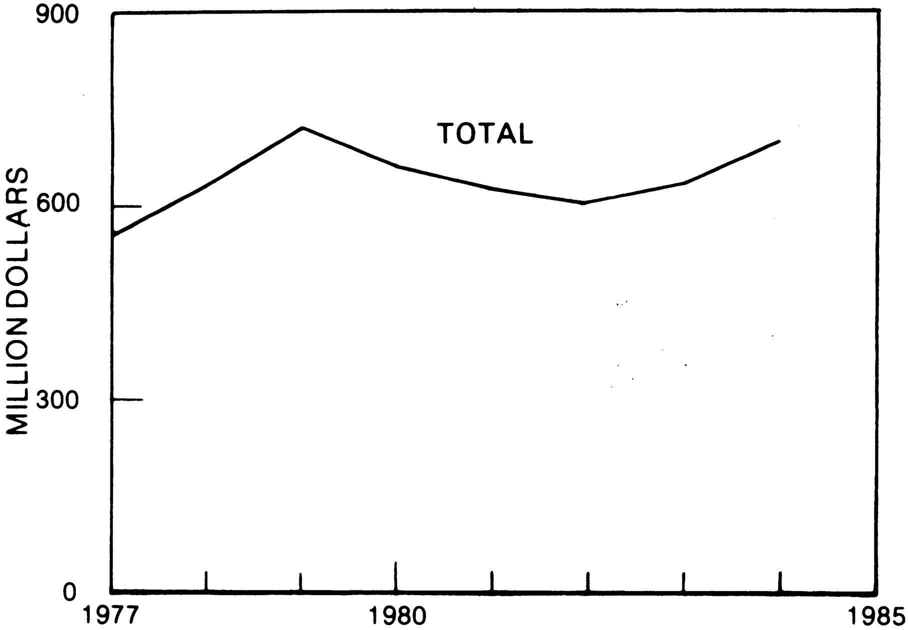

Figure 1.—Total value of nonfuel mineral production in Pennsylvania.

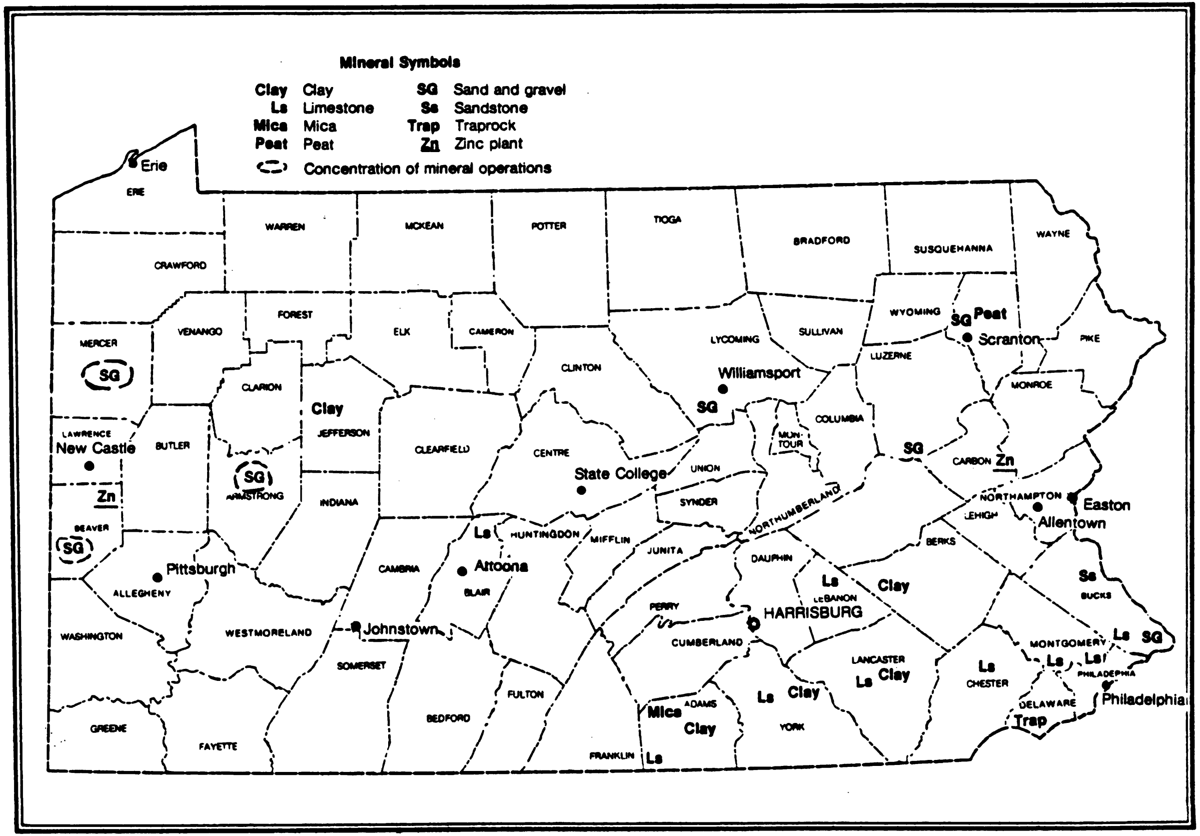

Figure 2.—Principal mineral producing localities in Pennsylvania.

**Legislation and Government Programs.**—In 1984, the Surface Mining Conservation and Reclamation Act (SMCRA) was amended (House Bill 1176) to provide separate requirements for the State's noncoal mining industry. Previously, all mining activities in Pennsylvania were included in a single surface mining law. The amendment essentially differentiates the requirements for reclamation and contouring between coal and noncoal mining operations as provided in Subchapter E, Surface Non-Coal Mining Operations, Section 77.102 of the SMCRA.

Public Act 158 (Senate Bill 1309) amended State reclamation regulations to allow coal operators to re-mine abandoned sites without responsibility for previous water pollution. The legislation was expected to result in the mining of an estimated 300 million short tons of coal and provided a $75 million savings in reclamation costs. In 1984, the State received $44.3 million in abandoned mine reclamation funds from the Federal Office of Surface Mining.

Federal legislation concerning Pennsylvania in 1984 included enactment of the Pennsylvania Wilderness Act creating the State's first wilderness area in the 750,000-acre Allegheny National Forest. The law prohibits all oil, gas, mineral, and timber development in a tract of about 9,800 acres and authorized $2 million for purchase of oil, gas, and mineral rights in the wilderness area. The act also designated about 23,000 acres of the forest as a National Recreation Area, which allows limited development subject to environmental safeguards.

Also approved by the U.S. Congress was $42 million in funding for relocation of residents in Centralia and Bynersville in northeastern Pennsylvania. Underground coal mine fires have been spreading in the area since 1962 causing health and safety problems.

Unresolved at yearend was a proposal in the U.S. Congress to sell the federally owned Consolidated Railroad Corp. (Conrail) to private interests. About 15,000 Pennsylvanians are employed by Conrail, nearly 40% of the company's work force. Also, about 28% (4,014 miles) of the railroad's system is in the State. The State's steel, coal, and other mineral producers heavily dependent on rail transportation were concerned that the sale could result in abandonment of some routes and reduce competition in the East affecting freight rates.

The Pennsylvania Bureau of Topographic and Geologic Survey's mineral resources program completed a number of reports, including 1 on the geology and mineralogy of 55 copper-uranium occurrences in Lycoming and Sullivan Counties.[4] High-purity silica sources from 9 Paleozoic formations and 6 quartz veins were sampled, chemically analyzed, and described from 30 locations in 14 counties in central and eastern Pennsylvania.[5] The geology, mineralogy, mining, and milling of slate in Pennsylvania was summarized.[6] The State's slate industry produced flagging, flooring tiles, blackboards, roofing structural slates, and was the only U.S. producer of electrical and billiard slates in 1984.

Fetid barite occurrences from 11 locations were discovered and described in western Berks County. The host rock was a black shale of Cambro-Ordovician Age known as the Hamburg sequence.[7] A modern account of the brickmaking process at Watsontown in Northumberland County was described.[8] In addition, a kaolinitic white clay occurrence having medium- and high-duty refractory potential, as well as structural clay product potential, was discovered in Berks County.[9] The only active aggregate producer mining both sedimentary and crystalline rocks in the Reading Prong was described.[10] This operation mined a quartzite that was the only Pennsylvania Department of Transportation-approved bedrock source that met the highest skid resistance level for bituminous surfaces in southeastern Pennsylvania.

Continuing Survey projects included investigations on the distribution and uses of carbonate rocks, compilation of a directory of nonfuel mineral producers, a summary of the State's clay and shale mining industry in relation to construction markets, and a study of the petrologic and geographic distribution of uranium and thorium mineralization for the Reading Prong in eastern Pennsylvania. Reports on these projects were expected to be completed in 1985.

Also during the year, the U.S. Geological Survey evaluated a Noril'sk-type model for platinum-group mineralization associated with Jurassic diabase sheets.

Federal programs included ongoing health and safety research at the U.S. Bureau of Mines Pittsburgh Research Center. Demonstrated during the year was a new, more cost-effective method for treating acid mine drainage. Total capital cost for the new system was estimated at one-fifth of conventional systems based on preliminary tests.[11] The Bureau also allocated funds to the Mining and Mineral Resources Research Institute at Pennsylvania State University. This was designed to encourage the training of engineers and scientists in mineral-related disciplines.

The U.S. Department of Energy awarded a $33.7 million contract to KRW Energy Systems Inc. for development of a program in advanced coal gasification technology. The 32-month program will be conducted at KRW's facility in Madison, Westmoreland County, and focus on efficiently designing a system that produces environmentally clean gaseous and liquid fuels.

Federal- and industry-funded research efforts focused on clean energy technology. At the Homer City Generating Complex in Indiana County, three 600- to 650-megawatt pulverized coal-fired generating units, a state-of-the-art analytical coal laboratory, a 1,200-ton-per-hour coal cleaning technology plant, and a coal cleaning test facility were utilized in determining how different coals react to various cleaning processes and in studying ways of improving coal cleaning processes.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

In this section, nonfuel mineral commodities that were mined in Pennsylvania in 1984 are discussed. Quantity and value data for these commodities are given in table 1. Traditionally, cement and lime data are also presented in table 1. The State ranked ninth nationally in value of mineral production in 1984.

Other industrial minerals manufactured or processed in Pennsylvania from raw materials mined out-of-State or imported included graphite, gypsum, perlite, pyrophyllite, quartz crystal, slag, sulfur, sulfuric acid, and vermiculite. The combined value of these commodities was $97.2 million.

**Cement.**—Shipments in 1984 increased for the second consecutive year and improved nearly 1 million short tons compared with 1982 levels. The cement industry's performance in Pennsylvania reflected strong demand in the housing, highway, and commercial construction sectors. The housing market began to rebound in 1983, as interest rates declined and stabilized, increasing demand for cement for use in concrete foundations and floors. A shift in the economy in the Northeast toward more service, financial, and defense-related industries, as heavy manufacturing declined, spurred office building and commercial construction. Reconstruction of the interstate highway system also boosted cement sales in the eastern part of the State.

Cement data for Pennsylvania are divided into two districts: eastern Pennsylvania, which is all counties east of the eastern boundaries of Potter, Clinton, Centre, Huntingdon, and Franklin Counties; and western Pennsylvania, which is all other counties in the State. In 1984, the State's nine eastern plants produced 4.5 million tons of portland cement utilizing about 88% of capacity. The State's four western plants produced about 1.3 million tons of portland cement utilizing about 55% of capacity.

During the year, Keystone Portland Cement Co., Bath, was acquired by Giant Portland Cement Co., Columbia, SC. Giant Portland obtained 51% of Keystone's outstanding shares under a merger agreement valued at $15 million. Keystone's annual production capacity is 600,000 tons.[12]

Coplay Cement Manufacturing Co. acquired Louisville Cement Co.'s two plants in Logansport and Speed, IN, for about $112 million. Coplay, a subsidiary of Société des Ciments Français (SCF), operated a 1.1-million-ton-per-year-capacity plant in Nazareth, PA, and a 400,000-ton-per-year-capacity plant in Frederick, MD. The acquisition doubled SCF's annual capacity in the United States to about 3 million tons. SCF operated 15 plants in France with a total annual capacity of 10 million tons.[13]

Fuller International Inc., Bethlehem, PA, signed a 10-year contract with China to develop that country's cement technology. About 60% of China's cement production is from small plants with an average annual output of about 20,000 tons. The agreement with Fuller included plans to modernize plants, improve cement quality, conserve energy through use of more efficient machinery, and lower operating costs, particularly at the smaller plants.

**Clays.**—Production of clay and shale increased in 1984, ending a period of five consecutive years of decline. Demand, primarily from the cement industry, resulted in reversing the downward trend.

Although output improved in 1984, the State's clay industry remained depressed in comparison with that of the 1970's. In 1973, a 10-year record high 3 million short tons of clay and shale was produced. Also, about 225,000 tons of clay was used in production of about 8.6 million tons of portland cement. In 1984, Pennsylvania's total cement manufacturing production capacity was 7.5 million tons and clay used in manufacture totaled about 85,000 tons.

**Table 4.—Pennsylvania: Clays sold or used by producers, by use[1]**

(Short tons)

| Use | 1983 | 1984 |
|---|---|---|
| Common brick | 47,002 | 4,000 |
| Face brick | 723,576 | 761,237 |
| Firebrick, blocks and shapes | 24,373 | 15,524 |
| Flue linings | 22,631 | 24,220 |
| Mortar and cement, refractory | 10,993 | 38,812 |
| Portland and other cements | 51,429 | 85,107 |
| Tile: Drain, quarry, structural | 31,929 | 31,120 |
| Other[2] | 4,031 | 2,935 |
| Exports: Mortar, cement, other refractory | 260 | -- |
| Total | 916,224 | 962,955 |

[1] Excludes kaolin.

[2] Includes paint, lightweight aggregates, highway surfacing, and structural concrete.

**Gem Stones.**—Mineral specimens and semiprecious gem stones were collected by rockhounds and mineral dealers. Estimated value in Pennsylvania in 1984, was $5,000.

**Lime.**—Output increased slightly in 1984, primarily reflecting a similar gain by the State's steel industry. About 50% of the lime manufactured in the State was used in basic oxygen furnace and electric steelmaking. Most of the State's lime was produced in the southeastern part of the State.

Warner Co., one of the State's leading producers, continued operating the nearly depleted underground Bell Mine in Bellefonte. A nearby open pit limestone quarry was developed to supplement kiln feed and was expected to eventually replace the underground mine. Toward yearend, the firm laid off one-half of its employees, citing a slower than expected improvement in sales to the steel industry. About 40% of Warner's output was consumed by the steel industry. Sales increased for environmental uses, such as sulfur removal from stack gases, mine and plant acid water neutralization, and sewage treatment.[14]

**Table 5.—Pennsylvania: Lime sold and used by producers, by use**

| Use | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity (short tons) | Value (thousands) | Quantity (short tons) | Value (thousands) |
| Steel, basic oxygen furnace | 492,517 | $24,350 | 545,086 | $27,674 |
| Steel, electric | 223,111 | 11,085 | 222,673 | 10,960 |
| Sewage treatment | 153,594 | 8,267 | 180,399 | 9,827 |
| Acid water neutralization (mine or plant) | 93,681 | 5,130 | 97,379 | 5,827 |
| Water purification | 84,576 | 4,694 | 89,830 | 5,169 |
| Steel, open-hearth | 39,439 | 1,955 | W | W |
| Paper and pulp | 21,388 | 1,020 | 30,259 | 1,482 |
| Agriculture | 18,907 | 1,230 | 20,245 | 1,381 |
| Metallurgy, other | 1,415 | W | W | W |
| Other[1] | 378,130 | 23,951 | 433,832 | 27,862 |
| Total | 1,506,758 | 81,682 | 1,619,703 | 90,182 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes alkalies, animal and human food, briquetting (1984), desiccant (1984), explosives (1984), fiberglass (1984), glass, oil well drilling, other ore concentration, manganese, mason's lime, other chemical and industrial uses, paint, petroleum refining, refractories, sand lime brick, silica brick, soil stabilization, sugar refining, sulfur removal from stack gases, tanning, wire drawing, and uses indicated by symbol W.

**Mica.**—Gross Mineral Corp. mined mica (sericite) from an open pit near Fairfield in Adams County. The material was processed at a plant in Aspers for use as an extender and filler.

**Peat.**—In 1984, seven companies reported peat production. Most of the output came from Lackawanna, Luzerne, and Monroe Counties in the northeastern part of the State.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of sand and gravel increased for the first time since 1978, reflecting improved conditions in the construction industry. In 1984, sand and gravel was mined from 136 pits with the 20 largest accounting for 50% of the State's production. Permits to mine a total of about 16,000 short tons per day of sand and gravel in Beaver, Bucks, Franklin, and Wyoming Counties were pending with the State's Department of Environmental Resources (DER) for four companies at yearend.

Allegheny, Armstrong, and Beaver Counties accounted for about 23% of Pennsylvania's production and nearly 30% of the value of production, primarily because of strong demand from the Pittsburgh market. Much of the high-quality aggregate was dredged from the lower Allegheny River. Also indicative of that area's market, was an average unit price of $5.63 per ton, f.o.b. plant, for the three counties compared with an average price of $4.09 per ton for the remainder of the State's production.

**Table 6.—Pennsylvania: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 4,240 | $21,029 | $4.96 |
| Plaster and gunite sands | 358 | 1,741 | 4.87 |
| Concrete products | 322 | 1,687 | 5.23 |
| Asphaltic concrete | 1,443 | 6,997 | 4.85 |
| Road base and coverings[1] | 1,473 | 5,839 | 3.96 |
| Fill | 539 | 2,044 | 3.79 |
| Snow and ice control | 215 | 891 | 4.14 |
| Other[2] | 5,881 | 24,057 | 4.09 |
| Total or average | [3]14,472 | 64,285 | 4.44 |

[1] Includes road and other stabilization (cement).
[2] Includes roofing granules and other unspecified uses.
[3] Data do not add to total shown because of independent rounding.

During the year, an attempt by local officials to halt mining of sand and gravel in Mount Bethel, Northampton County, failed, but the effort was expected to continue in 1985. Stabler Co. Inc., the State's fifth leading producer, purchased a 28-acre site from Alpha Portland Cement Co. in 1983. The sales agreement included transfer of a permit from DER to mine sand and gravel at the site. Toward yearend, local officials appealed a county court decision that allowed mining, contending that mining violated zoning regulations.

In another action affecting one of the State's leading producers, the DER decided to evaluate permits for dredging operations on a case by case basis. Previously, compliance with standards on the amount of solid particles contained in waste water was required. The ruling allowed Davison Sand & Gravel Co. to continue operating the dredge *Allegheny*. The vessel is Pennsylvania's only dredge that processes riverbed material onboard and has been on operation for over 50 years on the Allegheny River. Until the ruling, Davison, which employed about 400 workers in 1984, was in violation of the standards and was expected to be shut down in 1985. The dredged material was used primarily for concrete aggregate.

Another of the State's dredging operators and major producers, Glacial Sand & Gravel Co., began using a high-pressure spray and gravity separation equipment to remove coal, wood, and other materials common in gravel deposits from the Allegheny River. The plant in Bridgeburg has the capacity to process about 375 tons of material per hour year-round.[15]

*Industrial.*—Production of industrial sand decreased 13% in 1984 compared with that of 1983. Three companies, one each in Allegheny, Carbon, and Huntingdon Counties, accounted for the output. More than one-half of the industrial sand produced was used in glass container manufacture.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Output in 1984 increased 9% in response to demand from the construction industry. During the year, a compromise was reached between J. M. Brenner Co. and local residents concerning reopening a limestone quarry near Lancaster. The agreement limited mining to 200,000 short tons per year for 4-1/2 years, and reclamation, blasting, and bonding procedures were detailed.

Warner Co.'s expansion plans for its Cedar Hollow Quarry near Devault in Chester County were approved by the DER, allowing the company to increase its 102-acre mining site by an additional 47 acres. The approval was conditional on Warner conducting water quantity and quality measurements and also stipulated that Warner must restore or replace any public or private water supplies that are contaminated or diminished by the quarry operation. The quarry, from which an average of about 4,000 tons per day of dolomite was mined, has been in operation since 1899.

Hempt Bros. Inc. continued efforts to obtain local approval for opening a 400,000-ton-per-year limestone quarry near Allen with reserves at that capacity for 32 years. The quarry plan opposed by a residents group was approved by local officials but appealed by the group to Cumberland County Court. Hempt Bros., originally expected to begin mining in September 1984, must also receive a DER permit after local approval.

Permits to mine about 4,300 tons of crushed stone per day in Fayette and Lackawanna Counties were pending with DER for two companies at yearend.

*Dimension.*—Sandstone, slate, and granite (diabase) were quarried. Most of the output of 44,000 short tons was produced in the eastern part of the State. Primary uses were for irregular-shaped stone, flagging, cut stone, and roofing slate. A new flagstone quarry in Somerset County, with a proposed production of about 400 tons per year, was in permit review by DER.

## METALS

Metal mining in Pennsylvania ceased in 1983 with the closing of the underground zinc mine at Friendsville. Commodities discussed in this section are processed from materials received from both foreign and domestic sources. Production and value data for these commodities are given if available. The value of nonfuel mineral production in Pennsylvania of $708.4 million in 1984 includes only the commodities discussed in the "Nonmetals" section.

**Abrasives.**—Three companies in western Pennsylvania manufactured metallic abrasives and steel shot and grit. Nationally, the State ranked first in production and operated 4 of the 12 plants in the United States. Silicon carbide, an artificial abrasive, was manufactured by one company in southwestern Pennsylvania.

**Beryllium.**—Brush Wellman Inc. announced a 3-year, $57 million expansion program to double manufacturing capacity of beryllium-copper strip. About $12 million was for two additional mill hardening furnaces and improvements to existing equipment at the company's Reading finishing facility. The expansion reflected a continuing growth in beryllium-copper demand from the electronics industry.[16]

Also in Reading, the Cabot Berylco Div. of the Cabot Corp. manufactured beryllium-copper strip and beryllium alloys. Cabot and Brush Wellman are the Western World's only beryllium-copper producers.

**Ferroalloys.**—In 1984, the State's ferroalloys industry reported production of 7,682 short tons valued at $32.6 million. The strong U.S. dollar, relative to foreign currencies, and low-priced imports continued to force ferroalloy producers to lower prices. Indicative of that trend in Pennsylvania was a comparison with 1980 output of 6,823 tons valued at $92.6 million; production in 1984 increased 13%, and value declined by $60 million. A slight measure of improvement in prices was indicated in October when Reading Alloys Inc., Robesonia, increased vacuum-grade ferrocolumbium prices to $17.70 per pound, f.o.b. plant.[17] Reading was one of five domestic producers of ferrocolumbium.

**Iron and Steel.**—In 1984, shipments of pig iron totaled 7.6 million short tons valued at $1.6 billion, up slightly from 1983 levels as was steel production, which totaled 14.4 million tons. Nationally, the State ranked third in both, accounting for 15% of the pig iron shipments and 16% of the steel production. Since 1979, the State's pig iron and steel shipment levels dropped 11.5 million tons and 13.8 million tons, respectively.

Plant closings and company restructuring during the past 5 years severely affected employment in the Pittsburgh area, which includes Allegheny, Beaver, Washington, and Westmoreland Counties. A decline of 56,200 jobs since the prerecession peak of 90,000 workers in 1979 left basic steel manufacturing employment in the area at an all-time low of 33,200 at yearend.[18] Nationally, for the same period, steel employment declined from 570,000 to 343,000 or by about 40%. In the Pittsburgh area, employment declined 62%.

In 1984, about 26 million tons of foreign steel was sold in the United States, which accounted for about a 26% share of the domestic market. Steel industry demands to reduce imports were addressed in September when the Federal Government announced a 5-year bilateral agreement program to restrict imports of certain types of steel. Through this program, agreements with foreign steel-producing countries were initiated to restrict imports of finished steel to 18.5% of the U.S. market.

USS continued restructuring its Monongahela Valley (Mon Valley) operations in southwestern Pennsylvania, shutting down two blast furnaces and a basic oxygen process furnace at its Duquesne plant. At the Clairton Coke Works, three of eight coke batteries were indefinitely shut down, eliminating 2,400 tons of coke production per day. The five operating batteries have about a 5,000- to 6,000-ton per day production capacity. USS also idled the coke batteries at its Fairless Coke Works in Bucks County. Coke for the Fairless Works was then supplied from Clairton.

In May, USS closed its Johnstown foundry operations after union members voted against contract concessions. The operation was purchased by local investors and renamed The Johnstown Corp. with partial production resuming in July. Also during the year, USS resumed rebuilding a blast furnace at the Edgar Thomson Works. The $81 million project had been suspended in 1982 and was the first major investment in the company's Mon Valley operations since that time. At yearend, employment at the Mon Valley operations, which comprised the bulk of USS steelmaking capacity in Pennsylvania, was about 5,050 with 11,200 workers laid off.

In an effort to aid unemployed steelworkers, USS and the United Steelworkers of America Union implemented a $4 million assistance program. Job search assistance and counseling was offered at centers in Pittsburgh, Fairless Hills near Philadelphia, Gary, IN, South Chicago, IL, and Cleveland, OH, for an estimated 10,000 dislocated workers.

USS and Bethlehem Steel joined in a 5-year, $33 million project to develop a process to directly cast 1-inch-thick slabs rather than 10-inch slabs produced with conventional casters. Thin slab casting was expected to result in $45-per-ton savings primarily because of reduced energy costs along with lower operating and equipment costs. About $29 million of the funding was provided by the U.S. Department of Energy, which was entitled to receive a return of one and one-half times its original investment if the technology is developed and marketed.[19]

Bethlehem Steel's restructuring plans included an $18 million expansion of its rail mill in Steelton. The plan was approved near yearend after union workers accepted a manning and work assignment agreement expected to reduce plant employment from about 2,600 to 2,000. The expansion at the Steelton plant, which is one of three domestic rail operations, would increase rail capacity by 50% to 450,000 tons per year and add the capability to produce rail in excess of 80 foot lengths. Bethlehem Steel also began a $50 million modernization project at its 48-inch structural mill at Bethlehem. At that mill, ingots are reduced into structural shapes such as I-beams used in construction. The project, which was expected to take 2 years to complete, was approved after union members agreed to negotiate revisions in work practices and work crews, both of which would reduce the work force. An agreement between Bethlehem Steel and Abex Corp., a subsidiary of IC Industries Inc., resulted in reopening steelmaking facilities in Somerset County. At midyear, Bethlehem Steel began purchasing a minimum of 10,000 tons of ingots monthly from Abex for finishing at its Johnstown bar, rod, and wire plant. The Abex facility had been closed since 1981.

LTV Steel Co. was formed through the merger of Jones & Laughlin Steel Corp., a subsidiary of LTV Corp., and Republic Steel Corp. The company indefinitely idled its Pittsburgh Works at midyear after reopening in January. Also idled was the firm's welded tube mills at the Aliquippa Works.

**Titanium.**—A. Johnson Metals Corp., Lionville, ceased production of ferrotitanium late in 1984, citing a competitive disadvantage because of low-priced imports. However, it continued to be a supplier of titanium scrap and produced as-cast titanium slab from scrap at its electron-beam furnace melting facility in Morgantown. In addition, this company became the exclusive agent for sales of calcium metal granules produced by Extramet Industries S.A.

of France.[20] Calcium metal is an additive in steelmaking for final deoxidation, desulfurization, and inclusion shape control.

**Zinc.**—Zinc mining in Pennsylvania ceased in 1983 with the closing of the Friendsville Mine. St. Joe Minerals Co., a subsidiary of Fluor Corp., the largest U.S. zinc smelting company, continued operating its 91,000-short-ton-per-year electrothermic zinc smelter at Monaca, PA. Zinc concentrates were shipped from St. Joe's Balmat and Pierrepont Mines in New York. The company also produced zinc oxide.

Zinc oxide was also produced by The New Jersey Zinc Co. Inc. at its 82,000-ton-capacity plant in Palmerton. Output dropped in 1984, primarily because of a 3-week strike by union workers at New Jersey Zinc's Sterling Mine in New Jersey.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] State geologist, Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, Harrisburg, PA.

[3] Economic geologist, Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, Harrisburg, PA.

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[15] Robertson, J. L. Spray/Gravity Removes Waste. Rock Prod., v. 87, No. 5, May 1984, pp. 37-40.

[16] American Metal Market. Electronics Growth Spurs Brush's Beryllium Expansion. June 28, 1984, p. 1.

[17] ———. Reading Alloys Raises Vacuum Ferrocolumbium to $17.70/lb. Sept. 21, 1984, p. 1.

[18] Commonwealth of Pennsylvania, Department of Labor and Industry. Layoffs in Steel Pull Factory Employment to New Low. Labor Mark. Lett. Pittsburgh Area, v. 38, No. 4, Fourth Quarter 1984, p. 2.

[19] United States Steel Corp. Development of Thin-Section Casting Promises Major Advance in Steelmaking. First Quarter Report, 1985, p. 7.

[20] American Metal Market. Johnson Metals Division To Market Calcium. Oct. 24, 1984, p. 10.

## Table 7.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Abrasives (manufactured): | | | |
| Durasteel Abrasives Co | 2601 Smallman St.<br>Pittsburgh, PA 15222 | Plant | Westmoreland. |
| Ervin Industries Inc | Box 1168<br>Ann Arbor, MI 48106 | do | Butler. |
| Pangborn Co | Etna St.<br>Butler, PA 16001 | do | Do. |
| Satellite Alloy Corp | Satellite Industrial Park<br>Box 171<br>Springdale, PA 15144 | do | Allegheny. |
| Cement: | | | |
| Hercules Cement Co | Center St.<br>Stockertown, PA 18083 | Plant and quarry. | Northampton. |
| Lone Star Industries Inc | Wood & Prospect St.<br>Box 270<br>Nazareth, PA 18064 | Plant | Do. |
| National Gypsum Co | 501 Hokes Mill Rd.<br>York, PA 17404 | do | Berks. |
| Société des Ciments Français | Tour Générale, Quartier Villon Cédex 22<br>192088 Paris, La Défense<br>France | Plants and quarries. | Lehigh and Northampton. |
| Clays and shale: | | | |
| Glen-Gery Corp | Box 1542<br>Reading, PA 19603 | Pits and plant | Adams, Berks, Northumberland, Union, York. |
| Hanley Brick Inc | 77 Pickering St.<br>Brookville, PA 15825 | Pit | Jefferson. |
| McAvoy Vitrified Brick Co | Phoenixville, PA 19460 | Pit | Chester. |
| Medusa Corp | Box 5668<br>Cleveland, OH 44101 | Pit | Lawrence. |
| Watsontown Brick Co | Box 68<br>Watsontown, PA 17777 | Pit | Northumberland. |
| Graphite (manufactured): | | | |
| Airco Speer Carbon Co | 800 Theresia St.<br>St. Marys, PA 15857 | Plant | Elk. |
| Keystone Carbon Co | 1935 State St.<br>St. Marys, PA 15857 | do | Elk. |
| The Stackpole Corp | St. Marys, PA 15857 | do | Elk. |

## Table 7.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Lime: | | | |
| Bethlehem Steel Corp.[1] | Martin Tower<br>Bethlehem, PA 18016 | Plants and quarries. | Adams and Lebanon. |
| Marblehead Lime Co | 300 West Washington St.<br>Chicago, IL 60606 | Plant and mine. | Centre. |
| Mercer Lime & Stone Co | 525 William Penn Pl.<br>Pittsburgh, PA 15219 | Plant | Butler. |
| Warner Co. | Yellow Springs Rd.<br>Devault, PA 19432 | Plant, mine, quarries. | Centre and Chester. |
| Peat: | | | |
| Corry Peat Products Co | 515 Turnpike Rd.<br>Corry, PA 16407 | Bog | Erie. |
| Gouldsboro Wayne Peat Co. | Box 68<br>Gouldsboro, PA 18424 | Bog | Lackawanna. |
| Hyponex Corp | 2013 South Anthony Blvd.<br>Fort Wayne, IN 46803 | Bog | Monroe. |
| Lake Benton Peat Moss | 622 South Blakely St.<br>Dunmore, PA 18512 | Bog | Lackawanna. |
| Perlite (expanded): | | | |
| Allied Block Chemical Co., Therm-O-Rock Div. | Pine St.<br>New Eagle, PA 15067 | Plant | Washington. |
| Pennsylvania Perlite Corp | Box 2002<br>Lehigh Valley, PA 18001 | Plants | Lehigh and York. |
| World Industries Inc | Lancaster, PA 17603 | Plant | Lancaster. |
| Sand and gravel: | | | |
| Construction: | | | |
| Davison Sand & Gravel Co | 3d Ave. and 4th St.<br>New Kensington, PA 15068 | Dredge and pit. | Armstrong and Westmoreland. |
| Dravo Corp. | 4800 Grand Ave.<br>Pittsburgh, PA 15222 | Dredge, pit, plant. | Allegheny and Beaver. |
| Glacial Sand & Gravel Co | Box 1022<br>Kittanning, PA 16201 | do | Armstrong. |
| Stabler Co. Inc.[1] | Box 3188<br>Wescoville, PA 18106 | Pits and plants. | Bradford and Northampton. |
| Warner Co. | 699 Bristol Pike<br>Morrisville, PA 19067 | Pit and plant | Bucks. |
| Industrial: | | | |
| McCrady Inc | Box 11566<br>Pittsburgh, PA 15238 | Quarries and plant. | Allegheny. |
| Pennsylvania Glass Sand Corp | Box 187<br>Berkeley Springs, WV 25411 | do | Huntingdon. |
| Slag—Iron and steel: | | | |
| Dunbar Slag Co. | Box 666<br>Sharon, PA 16146 | Plant | Mercer. |
| Standard Slag Co. | 1200 Stambaugh Bldg.<br>Youngstown, PA 44503 | do | Cambria. |
| Stone: | | | |
| Crushed: | | | |
| The General Crushed Stone Co., a subsidiary of Koppers Co. Inc. | Box 231<br>Easton, PA 18042 | Quarries and plants. | Berks, Bucks, Chester, Clinton, Columbia, Dauphin, Delaware, Lancaster, Montour, Tioga, York. |
| New Enterprise Stone & Lime Co. Inc. | R.D. 3<br>New Enterprise, PA 16664 | do | Adams, Bedford, Blair, Cumberland, Franklin, Huntingdon, Lancaster, Somerset. |
| Dimension: | | | |
| H. Dally & Sons Inc | Railroad Ave., Box 27<br>Pen Argyl, PA 18072 | Quarries and mills. | Northampton. |
| Delaware Quarries | Route 32<br>Lumberville, PA 18933 | Quarry | Bucks. |
| Media Quarry Co | 131 East 2d St.<br>Media, PA 19063 | do | Delaware. |
| Pennsylvania Granite Corp | Box 510<br>St. Peters, PA 19470 | do | Chester. |
| Sulfur (recovered): | | | |
| Atlantic Richfield Co | 3144 Passyunk Ave.<br>Philadelphia, PA 19145 | Refinery | Philadelphia. |
| United States Steel Corp | 400 State St.<br>Clairton, PA 15025 | Plant | Allegheny. |
| Vermiculite (exfoliated): | | | |
| W. R. Grace & Co. | 62 Whittemore Ave.<br>Cambridge, MA 02140 | do | Lawrence. |

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[1] Also stone.

# The Mineral Industry of Puerto Rico, Caribbean and Pacific Island Possessions, and Trust Territory of the Pacific Islands

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Department of Natural Resources, Commonwealth of Puerto Rico, for collecting information on all nonfuel minerals.**

**By Doss H. White, Jr.,[1] and Ivette E. Torres[2]**

## PUERTO RICO

In 1984, the value of nonfuel mineral commodities produced by the extractive mineral industry in Puerto Rico was $120.5 million, an increase of $7.2 million over that of 1983. Over 90% of the island's mineral output is used in Puerto Rican construction. A good year for construction is welcome news for the mineral industry, and 1984 was a good year for Puerto Rico's construction industry.

**Table 1.—Nonfuel mineral production in Puerto Rico[1]**

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Cement (portland) thousand short tons | 931 | $82,509 | 997 | $87,568 |
| Clays do | 125 | 251 | 128 | 266 |
| Lime do | 35 | 3,885 | 35 | 4,531 |
| Sand and gravel (industrial) do | NA | NA | 43 | W |
| Stone: | | | | |
| Crushed do | 5,536 | 26,611 | [e]5,813 | [e]27,675 |
| Dimension do | W | W | [e]35 | [e]455 |
| Total[2] | XX | 113,256 | XX | 120,495 |

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; not included in "Total." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Total does not include value of items withheld.

## Table 2.—Value of nonfuel mineral production in Puerto Rico, by district

(Thousands)

| District | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Aguadilla | -- | W | Stone (crushed). |
| Arecibo | -- | \$3,258 | Do. |
| Guayama | -- | W | Do. |
| Humacao | -- | W | Do. |
| Mayaguez | -- | 7,840 | Do. |
| Ponce | W | W | Cement, lime, clays, stone (crushed). |
| San Juan | W | W | Cement, stone (crushed), clays, stone (dimension). |
| Undistributed[1] | $^{r}$\$84,156 | 102,158 | |
| Total | $^{r}$84,156 | 113,256 | |

$^{r}$Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes some stone (crushed and dimension, 1982) and sand and gravel (industrial, 1983) that cannot be assigned to specific districts and values indicated by symbol W.

## Table 3.—Indicators of Puerto Rico business activity

| | | 1982$^{r}$ | 1983 | 1984$^{p}$ |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population[1] | thousands | 2,216 | 2,251 | 2,273 |
| Total civilian labor force[1] | do | 912 | 942 | 950 |
| Unemployment[1] | do | 208 | 220 | 198 |
| Employment (nonagricultural): | | | | |
| Mining total | do | .8 | .7 | .7 |
| Manufacturing total | do | 142.7 | 144.0 | 150.9 |
| Stone, clay, and glass products | do | 3.8 | 3.7 | 3.8 |
| Chemicals and allied products | do | 15.4 | 15.9 | 16.0 |
| Construction | do | 25.5 | 22.8 | 26.8 |
| Transportation and public utilities | do | 14.5 | 15.4 | 15.8 |
| Wholesale and retail trade | do | 108.1 | 108.3 | 113.8 |
| Finance, insurance, real estate | do | 28.8 | 28.2 | 28.9 |
| Services | do | 84.7 | 86.5 | 90.3 |
| Government and government enterprises | do | 236.7 | 240.1 | 253.2 |
| Total[2] | do | 641.6 | 645.9 | 680.3 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 37.5 | 38.7 | 38.4 |
| Total average hourly earnings, production workers | | \$4.64 | \$4.83 | \$5.00 |
| Construction activity: | | | | |
| Shipments of portland cement (by destination) | thousand short tons | 950 | 920 | 1,000 |
| Shipments of portland cement (by origin) | do | 986 | 931 | 997 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | \$84.2 | \$113.3 | \$120.5 |
| Value per capita | | \$38 | \$50 | \$53 |

$^{p}$Preliminary. $^{r}$Revised.

[1] Labor Force Division, Bureau of Labor Statistics, Department of Labor and Human Resources (Puerto Rico).

[2] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

**Trends and Developments.**—Key economic indicators exhibited a strength that had not been evident for several years. Construction activity was strong in both the private and public sectors, a positive sign since in past years activity relied heavily on the public sector, and during the recession of the early 1980's, private construction came to a virtual standstill.

Although the increase in construction activity created a strong demand for construction mineral commodities, the year was not without problems for one segment of the island's mineral industry—cement. Foreign cement producers, notably Costa Rican and Spanish, viewed the resurgence in construction and demand for materials as an invitation to increase cement exports to Puerto Rico. In June, the island's cement producers countered by petitioning the U.S. Department of Commerce for relief. In September, Commerce found that Costa Rica was providing a tax exemption on income from cement production and issued a preliminary decision to subject Costa Rican cement imports to a countervailing duty. Late in the year, Barbados cement began to make inroads into the Puerto Rican cement market.

The island's cement industry also complained to the Puerto Rican Consumer Affairs Department (DACO) that cement importers were importing substandard quality cement at unfair prices.

**Legislation and Government Program.**—During 1984, the Puerto Rican Division of Geology continued the islandwide reconnaissance geochemical survey. Stream sediment, soil, and rock samples were collected and analyzed for mineral potential; at yearend, approximately 80% of the island had been sampled. Anomalous areas of mineralization will be targeted for detailed investigation.

The division, in conjunction with the U.S. Geological Survey (USGS), continued the program of mapping the geology of the island's insular shelf. High-resolution seismic and vibracore tests were conducted to evaluate offshore sand and gravel and heavy mineral potential.

A consultant group prepared a report on the island's petroleum potential. Many of the data used in the report were from division files.

The U.S. Bureau of Mines, the leading minerals data and engineering agency in the Federal Government, canvassed all mineral producers on the island as part of an annual program to develop baseline data on mineral production and value. The canvass was part of a nationwide program to determine demand, mineral usage trends, and possible areas of shortage prior to actual occurrence.

The USGS began a 1-year program to analyze the island's drinking water. Results from the study, undertaken in conjunction with the Aqueducts and Sewer Authority, will be released in 1985.

## REVIEW BY NONFUEL MINERAL COMMODITIES

**Nonmetals.**—The island's industrial minerals industry produced cement, clays, lime, salt, sand and gravel, and stone. Graphite products and byproduct sulfur comprise the remaining segment of the Puerto Rican mineral industry. The $7.2 million increase in value of extractive mineral production was directly related to the increase in construction activity.

*Cement.*—Puerto Rican Cement Co. Inc. in Ponce and San Juan Cement Co. near San Juan comprise the island's cement industry.

For the past few years, foreign cement imports have been under careful scrutiny by the two cement producers. In 1983, foreign cement comprised 2.8% of the cement used; this figure climbed to 3.7% for the first 9 months of 1984.[3]

Both Puerto Rican cement producers' plants were designed to use the energy-intensive wet process. Newer Caribbean and Spanish plants designed for the dry process can compete in the Puerto Rican market, even when shipping charges are added to the production costs.

In 1983 the two Puerto Rican cement companies complained to the island's DACO that foreign cement, inferior to that produced on Puerto Rico, was being imported and sold cheaper than the local product.[4] In March, the president of the import company, Hasser & Associates Inc., a Spanish firm, replied to the Commerce and Industry Commission that Puerto Rican cement was 40% more expensive than U.S. cement and that the imported Spanish cement met standards adopted by the Puerto Rico Planning Board. Hasser & Associates obtained the cement from Hornos Ibericos S.A. of Spain and Empresa Nacional de Cemento of Costa Rica.

In June, the two Puerto Rican cement producers petitioned the U.S. Department of Commerce charging that they had "suffered substantial harm" because of competition from subsidized Costa Rican cement. The Department of Commerce found that Costa Rica was providing a 15% tax exemption on income derived, in addition to payroll deductions for producers who export their cement. At yearend, all parties were awaiting a decision by the U.S. International Trade Commission on assigning a 15% countervailing duty on Costa Rican cement exports to the United States.

It was reported that Costa Rica approached the Puerto Rican cement manufacturers to voluntarily curtail shipments or withdraw from the island's market, but the two companies chose to push for a countervailing duty.[5]

In July, Hasser Inc. dissolved Hasser & Associates and terminated cement purchase arrangements with the Spanish and Costa Rican companies. Hasser Inc. or Haser Corp., which company was not made clear in news reports, will continue importing Spanish cement from "one of the mightiest cement manufacturers in Spain."[6]

In October, Union Maritima Internacional S.A. (UMAR), a former cement importer with Hasser & Associates, imported 2,000 short tons of cement from Arawak Cement Co. Ltd. in Barbados. Arawak is 51% owned by the Barbados Government and 49% by the Governments of Trinidad and Tobago. Published reports indicate UMAR will import 4,000 short tons per month.[7]

**Table 4.—Puerto Rico: Portland cement salient statistics**

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 2 | 2 |
| Production | 927,314 | 998,565 |
| Shipments from mills: | | |
| Quantity | 931,453 | 996,839 |
| Value | $82,509,254 | $87,567,743 |
| Stocks at mills, Dec. 31 | 31,550 | 33,276 |

*Clays.*—Both cement companies and several clay companies mined clay as a raw material. Production by the cement companies was used in clinker manufacture, while the clay companies produced primarily brick and tile for island sales and for export.

*Graphite.*—Union Carbide Corp.'s Yabucoa facility produced synthetic graphite electrodes used in electric steel furnaces. Petroleum coke, a raw material in the electrode manufacture process, was obtained from the company's Penuelas operation.

*Lime.*—Chemical-grade lime was produced by Puerto Rican Cement Co. Inc. at its Ponce plant. Major markets were in Puerto Rico and the Virgin Islands, principally for water purification, aluminum and bauxite, and construction.

*Salt.*—One company, Cabo Rojo Enterprises, had an evaporative seawater saltworks on the island's southwest coast. A second salt operation was at La Parguera. Major markets were pharmaceutical and petrochemical producers, tuna packers, sugar mills, and curing and tanning plants.

*Sand and Gravel.*—Several stone companies produced a sand-size material as a coproduct of stone crushing; this material was used as a construction sand. In past years, the island's beach dunes were mined for construction material, but this practice was curbed by the Commonwealth government. It is not known whether any of the construction sand used by Puerto Rican construction firms was dune derived.

Owens-Illinois de Puerto Rico produced an industrial sand for bottle manufacture at a site near Vega Alte. Sand was mined by contract and trucked to the plant where it was washed, dried, and sized. The sand was then moved to the glass container plant where iron minerals were removed by magnetic separators, the sand was melted, and bottles were formed. The company produced about 65% of the glass containers used in Puerto Rico.

*Stone.*—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

U.S. Mine Safety and Health Administration records indicate that crushed stone was produced at 44 quarries in all 7 of the island's districts during 1984. In 1983, the principal stone type produced was limestone (64.6%), followed by traprock (20.7%), marble (8.9%), and granite (5.8%). One company, in the San Juan District, produced a dimension traprock for rubble sales.

**Metals.**—The island has a small but vigorous metal industry. In calendar year 1983, the latest year with data available, Puerto Rico shipped $1.5 billion worth of metal products to the United States, a 6.6% increase over 1982 shipments.[8]

Despite the increase in exports, the island's metal producers faced stiff competition from foreign firms. As an example, imports of Japanese steel rods have entirely displaced local manufacture of steel reinforcement rods previously produced at small foundries.

## CARIBBEAN ISLAND POSSESSIONS

Excluding Puerto Rico, U.S. possessions in the Caribbean consists of the U.S. Virgin Islands; Navassa Island south of Guantanamo, Cuba; the Swan and Corn Islands off the Honduran and Nicaraguan coasts; and the Quita Sueño Banks, Roncador Banks, Serrana, and the Serranilla Banks approximately 250 miles east of the coast of Central America. The U.S. Virgin Islands was the only U.S. Territory in the Caribbean reporting mineral production.

## U.S. VIRGIN ISLANDS

St. Croix, St. John, St. Thomas, and several smaller islands comprise the U.S. Virgin Islands. These West Indies possessions are 40 to 60 miles east of Puerto Rico. Mineral producers were active on both St. Thomas and St. Croix. Industrial mineral production on the two islands consists of construction sand and traprock for aggregate. Major hotels were started on both islands, which increased the demand for construction mineral commodities.

St. Croix was the site of two major refineries, the Amerada Hess Corp. petroleum refinery and the Martin Marietta Aluminium Corp. alumina refinery. During the year, the former was affected by labor problems and the latter by economic conditions.

The contract between Amerada Hess and the United Steelworkers of America expired on April 15 and 377 union workers were locked out the next day. The lockout continued through yearend. The 700,000-barrel-per-day refinery complex is the world's largest.

In October, Martin Marietta announced it was quitting the aluminum business and that it had buyers for several plants. The St. Croix plant was slated to be sold separately or closed. The facility represents approximately 12% of U.S. alumina capacity.

## PACIFIC ISLAND POSSESSIONS

Several islands between 160° and 180° longitude East represent U.S. territory in the Pacific Ocean. These include American Samoa, Canton, Enderburg, Guam, Jarvis, Johnson, Midway, Palmyra, and Walker. These islands were acquired for harbors, coaling stations, or seaplane fueling points.

American Samoa and Guam were the only areas reporting mineral production—volcanic rock and coral crushed for aggregate applications. Cement was imported and sand was mined locally for concrete usage. It was possible that some of the other island possessions have intermittent stone and sand quarries.

## TRUST TERRITORY OF THE PACIFIC ISLANDS

The Marshall Islands, the Eastern and Western Caroline Islands, and the Northern Mariana Islands, collectively termed Micronesia, cover an ocean area roughly the size of the United States. Micronesia includes more than 2,000 islands totaling less than 700 square miles. This area is the Trust Territory of the Pacific Islands.

In 1903, German engineers conducted the first systematic mineral resource investigation in the area, and German firms produced an unknown tonnage of phosphate rock prior to Japan occupying the islands in World War I. Japan was granted control of the islands at the end of the conflict, and Japanese geologists carried out an extensive exploration program throughout the area. Japanese mining companies were active on several of the islands during 1936-44.

The United States gained possession of the islands during 1943-45, and in 1947, Micronesia was placed under the newly formed United Nations trusteeship system. Following the termination of hostilities in 1945, phosphate mining facilities were rebuilt on Angura in the Palau District and mining by the Japanese resumed under U.S. direction. In 1955, mining terminated.

Negotiations for posttrusteeship status began in 1969, and by 1984, four separate political components had been established: (1) Northern Mariana Islands, (2) Palau District, (3) Marshall Islands, and (4) Federal States of Micronesia composed of the former Districts of Yap, Truk, Ponope, and Kosrae.

Citizens of the Northern Marianas chose to become a U.S. Commonwealth, which was approved by the U.S. Congress. The area remains part of the trust territory until the trusteeship agreement is terminated.

The other three areas each enacted a constitution, established governments, and will become free states when the trusteeship is terminated.

Although construction minerals were the principal commodities mined in 1984, table 5 notes the occurrence of minerals and past mining activity in the trusteeship area.

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] Program Assistant, Washington, DC.

[3] Caribbean Business. U.S. May Impose Duty on Costa Rica Cement. Oct. 3, 1984.

[4] ———. Cement Hearings Resume This Week. Jan. 11, 1984.

[5] Caribbean Business. Island's Cement Industry Protects Its Territory. Oct. 3, 1984.

[6] ———. Hasser Finds New Source of Cement. Oct. 17, 1984.

[7] ———. Barbadian Cement Company Breaks into P.R. Market. Oct. 24, 1984.

[8] ———. Puerto Rico-U.S. Trade Drops 6.4% in 1983. June 27, 1984.

## Table 5.—Trust Territory of the Pacific Islands: Mineral occurrences and past mining activity

| Mineral | Northern Marianas | Marshall Islands | Palau District | Federated States of Micronesia |
|---|---|---|---|---|
| METALS | | | | |
| Antimony | | | O | |
| Bauxite | O | | M | O |
| Copper | | | O | M |
| Gold | O | | O | O |
| Iron oxides | O | | | |
| Limonite | O | | M | M |
| Manganese | M | | M | O |
| Silver | O | | | |
| Zinc | O | | O | |
| NONMETALS | | | | |
| Asbestos | | | | O |
| Clays | O | | M | O |
| Phosphate | M | M | M | M |
| Sand | O | O | O | O |
| Stone | O | O | O | O |
| Sulfur | M | | | |

M Previously mined. O Occurrence only.

Source: Department of Resource and Development, Trust Territory of the Pacific Islands.

# The Mineral Industry of Rhode Island

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Rhode Island Department of Environmental Management for collecting information on all nonfuel minerals.**

### By L. J. Prosser, Jr.[1]

The value of nonfuel mineral production in Rhode Island reached a record high of $11.6 million in 1984.

Demand for crushed stone and construction sand and gravel remained strong, reflecting improved conditions in the construction industry for the second consecutive year. Since the bottoming of the recession in 1982, the combined output of sand and gravel and crushed stone doubled in 1984 over that of 1982.

**Table 1.—Value of nonfuel mineral production in Rhode Island, by county[1]**

(Thousands)

| County[2] | 1983 | 1984 | Minerals produced in 1984 in order of value |
|---|---|---|---|
| Kent | (3) | $2,075 | Sand and gravel (construction). |
| Newport | $86 | -- | |
| Providence | 5,421 | 2,566 | Sand and gravel (construction). |
| Washington | W | 641 | Do. |
| Undistributed[4] | 23 | 486 | |
| Sand and gravel (construction) | $^{e}$2,400 | XX | |
| Stone: | | | |
| Crushed | XX | $^{e}$5,800 | |
| Dimension | XX | W | |
| Total | 7,930 | 11,568 | |

$^{e}$Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] County distribution for construction sand and gravel (1983) and crushed and dimension stone (1984) is not available; total State values are shown separately under "Sand and gravel (construction)" or "Stone."

[2] Bristol County is not shown because no nonfuel mineral production was reported.

[3] Construction sand and gravel was produced.

[4] Includes gem stones and industrial sand and gravel (1984) that cannot be assigned to specific counties and value indicated by symbol W.

### Table 2.—Indicators of Rhode Island business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 953 | 956 | 962 |
| Total civilian labor force | do | 480 | 475 | 490 |
| Unemployment | do | 49 | 39 | 26 |
| Employment (nonagricultural): | | | | |
| Mining total | do | 0.2 | 0.1 | 0.1 |
| Nonmetallic minerals except fuels[1] | do | .1 | .1 | NA |
| Oil and gas extraction[1] | do | .1 | ([2]) | NA |
| Manufacturing total | do | 116.6 | 116.2 | 120.6 |
| Primary metal industries | do | 6.5 | 6.0 | 6.1 |
| Stone, clay, and glass products | do | 1.9 | 2.0 | 1.8 |
| Chemicals and allied products | do | 3.2 | 3.0 | 3.1 |
| Petroleum and coal products[1] | do | .1 | .1 | NA |
| Construction | do | 10.9 | 11.6 | 12.6 |
| Transportation and public utilities | do | 13.2 | 13.3 | 13.7 |
| Wholesale and retail trade | do | 80.5 | 83.5 | 88.0 |
| Finance, insurance, real estate | do | 21.2 | 21.5 | 22.6 |
| Services | do | 90.1 | 93.2 | 97.2 |
| Government and government enterprises | do | 57.8 | 56.9 | 57.4 |
| Total | do | 390.5 | 396.3 | 412.2 |
| Personal income: | | | | |
| Total | millions | $10,417 | $11,171 | $12,331 |
| Per capita | | $10,931 | $11,691 | $12,820 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.6 | 39.0 | 40.9 |
| Total average hourly earnings, production workers | | $6.61 | $6.92 | $7.23 |
| Earnings by industry: | | | | |
| Farm income | millions | $12 | $10 | $9 |
| Nonfarm | do | $6,865 | $7,472 | $8,302 |
| Mining total | do | $5 | $3 | $3 |
| Nonmetallic minerals except fuels | do | $2 | $2 | $2 |
| Oil and gas extraction | do | $2 | $1 | $1 |
| Manufacturing total | do | $2,149 | $2,295 | $2,522 |
| Primary metal industries | do | $148 | $146 | $163 |
| Stone, clay, and glass products | do | $45 | $51 | $52 |
| Chemicals and allied products | do | $74 | $76 | $86 |
| Petroleum and coal products | do | $3 | $4 | $6 |
| Construction | do | $267 | $300 | $359 |
| Transportation and public utilities | do | $335 | $355 | $374 |
| Wholesale and retail trade | do | $1,029 | $1,141 | $1,271 |
| Finance, insurance, real estate | do | $408 | $465 | $521 |
| Services | do | $1,456 | $1,629 | $1,835 |
| Government and government enterprises | do | $1,183 | $1,241 | $1,337 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 2,683 | 3,856 | 4,161 |
| Value of nonresidential construction | millions | $75.0 | $95.7 | $129.8 |
| Value of State road contract awards | do | $23.6 | $63.9 | $152.2 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 133 | 150 | 202 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $4.8 | $7.9 | $11.6 |
| Value per capita | | $5 | $8 | $12 |

[p] Preliminary. [r] Revised. NA Not available.
[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[2] Less than 50 employees.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

**Legislation and Government Programs.**—The Rhode Island State Planning Office, under section 42-11-10(b) of the General Laws, began revising the State Land Use Policies and Plan adopted in 1975. Work began on identifying demographic, economic, and land use changes between 1970 and 1980 to provide background for extending the planning horizon to the year 2010. The 1975 plan targeted land use policies to 1990. Among the items to be addressed or updated in the plan are air quality, acid rain, local zoning ordinances, energy versus recreational use of waterways, and land capability. The plan was scheduled for completion in September 1985; additional information may be obtained from the Rhode Island Department of Administration, Office of State Planning, 265 Melrose Ave., Providence, RI 02907, telephone (401) 277-2656.

A $250 million proposal (Greenhouse Compact) to revitalize Rhode Island's economy, proposed by the State in 1983, was defeated in a June 1984 referendum. The proposal was designed to encourage economic development and create jobs by fostering new industries and strengthening old ones.

Activities related to the State's mineral industry involving government agencies included a report on the Providence Harbor by Rhode Island's Coastal Resources Management Council.[2] In the report, dredging, dredging disposal, and underutilization of the terminal capacity were cited as problem areas. The report also recommended identifying which new commodities the port may be best suited to handle because of the decline in petroleum products since the early 1970's. Nonpetroleum cargo handled at the port in 1984 was 623,361 short tons. Primary imports were cement (160,644 tons) and steel (175,441 tons); the major export was scrap metal (59,925 tons).

Rhode Island was 1 of 17 States involved in a second U.S. Department of Energy (DOE) study to site a repository for high-level radioactive waste and spent nuclear fuel. By May 1986, DOE was expected to identify 15 to 20 areas of crystalline rock for further study as a potentially acceptable site for the repository. Overall, more than 230 areas were under consideration. During 1984, the Office of State Planning (OSP) reviewed DOE's regional characterization report for Rhode Island, which compared locations of potentially favorable rock bodies with population densities, environmental factors, and geologic features considered adverse to siting. OSP's comments on the report were required by March 1985. As an indirect benefit of the project, much of Rhode Island's published geologic data and maps, which are several decades old, will be updated.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

Rhode Island's mineral production again paralleled the cyclical demand for aggregate from the construction industry. Recovery in that industry during 1983 and 1984 is indicated in the value of contract awards, which in both years more than doubled the 1982 total. Contract award values by type of construction activity were as follows:

| Type of construction activity | Value of contract awards (millions) | | |
|---|---|---|---|
| | 1982 | 1983 | 1984 |
| Residential | $129.6 | $209.1 | $237.8 |
| Nonresidential | 86.6 | 200.4 | 195.6 |
| Public works and utilities | 34.2 | 104.1 | 111.2 |
| Total | 250.4 | 513.6 | 544.6 |

Source: Rhode Island Department of Economic Development.

Similarly, combined output of crushed stone and construction sand and gravel increased 54% in 1983 and 95% in 1984 compared with 1982 production as shown below:

| Commodity | Quantity (thousand short tons) | | |
|---|---|---|---|
| | 1982 | 1983 | 1984 |
| Sand and gravel (construction) | 1,146 | [e]1,000 | 1,483 |
| Stone (crushed) | [e]130 | 971 | [e]1,000 |
| Total | 1,276 | 1,971 | 2,483 |

[e]Estimated.

**Sand and Gravel.**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of construction sand and gravel increased after 4 consecutive years of decline. Although production increased to about 1.5 million short tons, that total was well below the recent peak output of 3.5 million tons in 1979.

The number of active pits in the State has declined from 22 in 1980 to 14 in 1984, while the value per ton (f.o.b. plant) has increased from $1.97 in 1980 to $3.56 in 1984. All of Rhode Island's production came from three of the State's five counties, Kent, Providence, and Washington.

**Table 3.—Rhode Island: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 232 | $713 | $3.07 |
| Plaster and gunite sands | W | W | 5.00 |
| Asphaltic concrete | W | W | 3.07 |
| Road base and coverings | 58 | 316 | 5.42 |
| Fill | 74 | 118 | 1.59 |
| Snow and ice control | 101 | 227 | 2.24 |
| Other | 1,018 | 3,908 | 3.84 |
| Total or average | 1,483 | 5,282 | 3.56 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—In 1984, output reached 1 million short tons for the first time in Rhode Island. Since 1983, crushed stone has replaced sand and gravel as the State's leading mineral commodity in value and nearly equaled it in production. This change indicated a dwindling supply of quality gravel and the resultant increase in crushed stone as a substitute aggregate material.

*Dimension.*—One company in Westerly, Washington County, continued to produce a minor amount of dimension granite, primarily for monumental use.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] Robadue, D. D., Jr. Providence Harbor: A Special Area Management Plan. Aug. 1984, 87 pp.

**Table 4.—Principal producers**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Sand and gravel: | | | |
| A. Cardi Construction Co. Inc | 451 Arnold Rd.<br>Coventry, RI 02816 | Pits and plant | Kent. |
| Holliston Sand Co.[1] | Box 393<br>Slatersville, RI 02876 | Pit and plant | Providence. |
| J. H. Lynch & Sons Inc.[2] | Box 325<br>Ashton, RI 02864 | do | Do. |
| Richmond Sand & Gravel Co | Pole 175, Farnum Pike<br>Smithfield, RI 02917 | Pit | Washington. |
| River Sand & Gravel Co. Inc | 101 Ferris St.<br>Pawtucket, RI 02861 | Pit and plant | Kent. |
| South County Sand & Gravel Co. Inc. | North Rd.<br>Peace Dale, RI 02878 | do | Washington. |
| Stone: | | | |
| Forte Bros. Inc | 14 Whipple St.<br>Berkley, RI 02864 | Quarry | Providence. |
| Tilcon Inc | 875 Phoenix Ave.<br>Cranston, RI 02920 | do | Do. |

[1] Also industrial sand.

[2] Also stone.

# The Mineral Industry of South Carolina

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the South Carolina Geological Survey, State Division of Research and Statistical Services, for collecting information on all nonfuel minerals.**

**By Doss H. White, Jr.,[1] and Arthur H. Maybin[2]**

In 1984, the value of South Carolina's nonfuel extractive mineral production totaled $275.8 million. This was a new record and exceeded the previous record established in 1983 by $45.3 million.

South Carolina ranked 14th in mineral value among the 26 Eastern States and 26th nationally. The State ranked second nationally in kaolin and vermiculite sales and in the top 10 States in the output of ferroalloys, fuller's earth, and masonry cement.

**Table 1.—Nonfuel mineral production in South Carolina[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Cement, portland thousand short tons | W | W | 2,319 | $103,891 |
| Clays[2] do. | 1,813 | $34,830 | 1,834 | 36,809 |
| Gem stones | NA | 10 | NA | 10 |
| Manganiferous ore thousand short tons | 22 | W | 20 | W |
| Peat do. | W | W | 5 | W |
| Sand and gravel: |  |  |  |  |
| Construction do. | [e]5,200 | [e]15,000 | 5,845 | 17,097 |
| Industrial do. | 842 | 13,169 | 882 | 14,889 |
| Stone: |  |  |  |  |
| Crushed do. | 15,786 | 61,054 | [e]17,900 | [e]72,500 |
| Dimension do. | 17 | 1,165 | [e]16 | [e]1,092 |
| Combined value of cement (masonry), clays (fuller's earth), mica (scrap), vermiculite, and values indicated by symbol W | XX | 105,366 | XX | 29,562 |
| Total | XX | 230,594 | XX | 275,850 |

[e] Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in South Carolina, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Abbeville | W | $36 | Stone (crushed). |
| Aiken | $24,376 | 29,992 | Clays. |
| Anderson | (2) | W | Stone (crushed). |
| Berkeley | (2) | W | Do. |
| Charleston | W | (3) | |
| Cherokee | 635 | W | Stone, clays, manganese. |
| Chesterfield | 1,414 | W | Stone (crushed), clays. |
| Colleton | W | W | Peat. |
| Dorchester | 41,072 | W | Cement, stone (crushed), clays. |
| Edgefield | 107 | W | Clays. |
| Fairfield | (2) | W | Stone (crushed), stone (dimension). |
| Florence | W | (3) | |
| Georgetown | (2) | W | Stone (crushed). |
| Greenville | W | W | Do. |
| Greenwood | W | W | Stone (crushed), clays. |
| Horry | 190 | W | Do. |
| Jasper | W | (3) | |
| Kershaw | W | W | Sand and gravel (industrial), stone (dimension), clays. |
| Lancaster | 2,045 | 1,444 | Mica (scrap), clays, stone (dimension). |
| Laurens | W | W | Vermiculite, stone (crushed). |
| Lee | 46 | (3) | |
| Lexington | 8,855 | W | Sand and gravel (industrial), stone (crushed), clays. |
| Marion | W | W | Clays. |
| Marlboro | W | 61 | Do. |
| Oconee | (2) | 554 | Stone (crushed). |
| Orangeburg | 36,885 | W | Cement, stone (crushed), clays. |
| Pickens | (2) | W | Stone (crushed). |
| Richland | 1,260 | W | Stone (crushed), clays. |
| Saluda | W | W | Clays. |
| Spartanburg | -- | W | Stone (crushed). |
| Sumter | W | W | Clays. |
| York | W | W | Stone (crushed). |
| Undistributed[4] | 23,929 | 183,508 | |
| Sand and gravel (construction) | XX | [e]15,000 | |
| Stone: | | | |
| Crushed | [e]53,000 | XX | |
| Dimension | [r] [e]1,164 | XX | |
| Total | [r]194,978 | [5]230,594 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of South Carolina business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 3,226 | 3,256 | 3,300 |
| Total civilian labor force | do. | 1,497 | 1,470 | 1,480 |
| Unemployment | do. | 162 | 148 | 105 |
| Employment (nonagricultural): | | | | |
| Mining total | do. | 1.7 | 1.7 | 1.8 |
| Manufacturing total | do. | 364.3 | 362.3 | 378.2 |
| Primary metal industries | do. | 6.3 | 6.4 | 7.4 |
| Stone, clay, and glass products | do. | 10.1 | 10.2 | 10.6 |
| Chemicals and allied products[1] | do. | 32.1 | 32.5 | NA |
| Petroleum and coal products[1] | do. | .4 | .4 | NA |
| Construction | do. | 64.6 | 70.3 | 81.6 |
| Transportation and public utilities | do. | 53.6 | 54.0 | 55.5 |
| Wholesale and retail trade | do. | 230.8 | 239.4 | 262.0 |
| Finance, insurance, real estate | do. | 48.9 | 50.9 | 54.4 |
| Services | do. | 169.8 | 179.0 | 196.6 |
| Government and government enterprises | do. | 228.1 | 230.3 | 240.1 |
| Total[2] | do. | 1,162.0 | 1,188.0 | 1,270.3 |
| Personal income: | | | | |
| Total | millions | $27,787 | $30,062 | $33,385 |
| Per capita | | $8,612 | $9,232 | $10,116 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.2 | 40.6 | 40.8 |
| Total average hourly earnings, production workers | | $6.68 | $7.03 | $7.28 |
| Earnings by industry: | | | | |
| Farm income | millions | $281 | $108 | $335 |
| Nonfarm | do. | $20,040 | $21,948 | $24,388 |
| Mining total | do. | $32 | $34 | $38 |
| Manufacturing total | do. | $6,440 | $7,035 | $7,780 |
| Primary metal industries | do. | $160 | $174 | $226 |
| Stone, clay, and glass products | do. | $208 | $238 | $265 |
| Chemicals and allied products | do. | $861 | $956 | $1,035 |
| Petroleum and coal products | do. | $13 | $15 | $16 |
| Construction | do. | $1,206 | $1,398 | $1,655 |
| Transportation and public utilities | do. | $1,384 | $1,538 | $1,667 |
| Wholesale and retail trade | do. | $2,850 | $3,096 | $3,526 |
| Finance, insurance, real estate | do. | $832 | $950 | $1,073 |
| Services | do. | $2,701 | $2,997 | $3,388 |
| Government and government enterprises | do. | $4,507 | $4,814 | $5,156 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 18,371 | 30,197 | 34,197 |
| Value of nonresidential construction | millions | $627.2 | $571.2 | $614.5 |
| Value of State road contract awards | do. | $87.7 | $122.0 | $178.6 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 836 | 964 | 1,100 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $195.0 | $230.6 | $275.9 |
| Value per capita | | $60 | $71 | $84 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[2] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

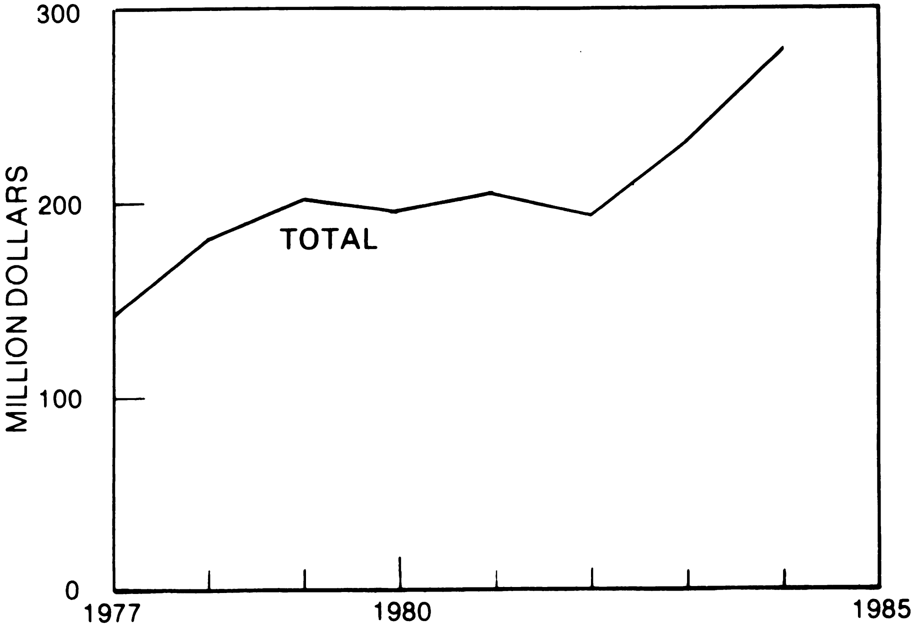

Figure 1.—Total value of nonfuel mineral production in South Carolina.

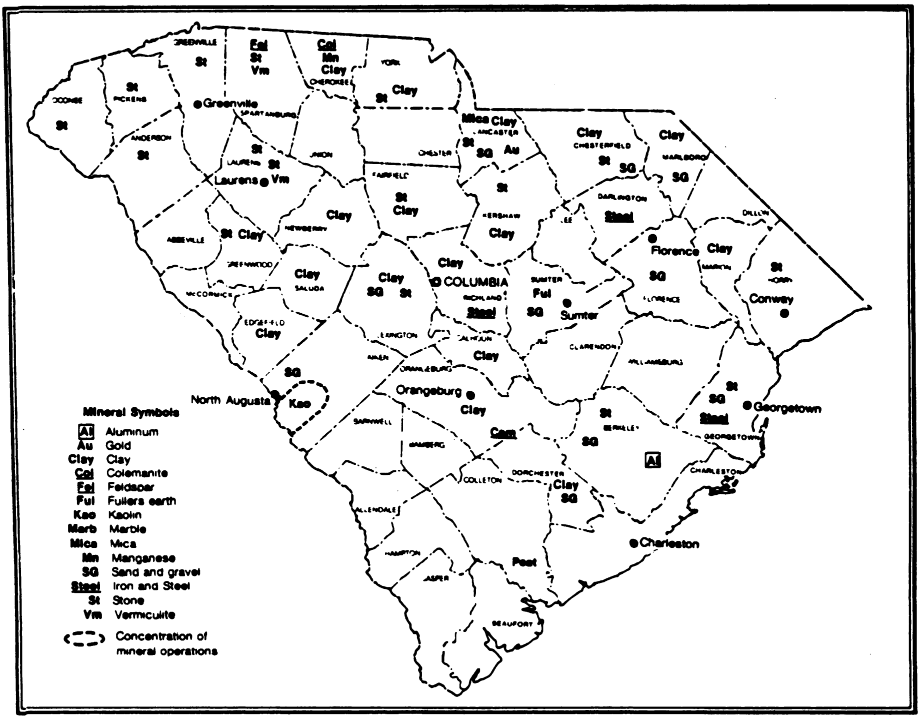

Figure 2.—Principal mineral producing localities in South Carolina.

**Trends and Developments.**—For the second consecutive year "Palmetto State" mineral producers reported record-high sales; mineral commodities used in the construction industry—portland cement, common clay, construction sand and gravel, and crushed stone—accounted for approximately 71% of the sales reported, reflecting the construction industry's strong recovery from the 1981-82 recession. Indicators of South Carolina construction activity during 1984 are listed in table 3.

The second largest sector of the mineral industry was kaolin, which accounted for 12% of the total mineral value. South Carolina's kaolin output, which ranked second behind Georgia, provided a basic raw material for several score industrial applications.

The strong recovery experienced by the Nation's economy was, in part, responsible for a number of new projects and plant and/or equipment expansions within the State's extractive mineral industry or industry that used mineral products as a raw material. A summary of new activity in the industrial minerals sector in 1984 is listed in the following tabulation:

| Company | Location | Remarks |
|---|---|---|
| Carolina Vermiculite Inc | -- | Applied for mining permits in Spartanburg and Laurens Counties. |
| Giant Portland & Masonry Cement Co | Columbia | Purchased controlling interest in Keystone Portland Cement Cocapacitor plant. |
| Gifford-Hill & Co. Inc | Harleyville | Completed expansion-modernization and upgrading of a kiln preheater. |
| W. R. Grace & Co | Enoree | Developed new, less expensive vermiculite product line. |
| Pennsylvania Glass Sand Corp | Columbia | Increased capacity and automated sand production and packaging facilities. |
| Santee Portland Cement Corp | Holly Hill | Installed feeder-breaker for cement clinker reclamation. |
| Vulcan Materials Co | Wellford | Obtained State permits for $2 million stone quarry operation. |

Activity was also brisk in several areas of the State's metal industry. Excluding aluminum, activity was of a positive nature. A summary of metal activity in 1984 follows:

| Company | Location | Remarks |
|---|---|---|
| Alumax Inc | Mount Holly | Decreased aluminum production by 13,000 metric tons per year. |
| Macalloy Inc | Charleston | Received $26 million contract to convert 141,601 tons of chrome ore into high-carbon ferrochromium in 1985. |
| Grede Foundries Inc | Milwaukee, WI | Purchased Roberts Foundry in Greenwood, SC. |
| Georgetown Steel Corp | Georgetown | Sold its 50% interest in Addlestone International Corp., Charleston, a major ferrous scrap processor and broker. Restarted direct-reduced iron facility. |
| Nucor Corp | Darlington | Developing flat-rolling technology for minimills. |

At yearend, South Carolina was on the brink of again becoming a leading gold producer in the Southeastern United States. Piedmont Mining Co. was completing work on a heap leach gold recovery project at the Haile Mine near Kershaw. Startup was scheduled for early 1985.

A major controversy in South Carolina during 1984 centered on a former surface mine in Sumter County. In 1972, a fuller's earth mine was opened near Pinewood. The operation used oil as a fuel for fuller's earth drying, and on occasion the company had to take nonflammable waste liquid along with the flammable oil products. Surplus fuller's earth was used to absorb the nonflammable material, and in 1974, the company was granted an industrial waste permit. In 1975, the mine was purchased by SCA Services Inc.; in 1984, over 134,000 short tons of waste, 90% from 23 other States, Puerto Rico, and the Virgin Islands, was buried at the site.[3]

During the latter part of the year, the

Greenville, SC, News published several articles on the potential dangers of the landfill,[4] and some people feared that leakage from the site could contaminate one of South Carolina's most valuable resources—water. Late in October, the Governor stated that he would make "...significant recommendations regarding hazardous waste..." before leaving office in 1986.[5]

**Legislation and Government Programs.**—The 1984 legislation passed by the South Carolina General Assembly had no direct effect on the State's mineral producers. On the county level, the Sumter County Council approved an assistance agreement to finance an expansion for Mid-Florida Mining Co., which mines and processes a clay absorbent at the SCA Services hazardous waste disposal site in Pinewood.[6] Mining company representatives gave the council a letter stating that the council was not obligated to continue with the bond ordinance until a bond purchase commitment was obtained.

In February, the State Land Resources Commission named W. R. Grace & Co. recipient of the 1983 Mined Land Reclamation Award. The annual award recognizes a company demonstrating outstanding reclamation efforts. The Land Resources Commission also presented a Certificate of Merit to the J. M. Huber Corp. for reclamation at the Richardson Mine near Langley.

The South Carolina Geological Survey during 1984 continued work on mapping the State's geology and provided aid to several companies interested in the State's mineral potential. Mineral deposits in the Blue Ridge and Chauga belts and areas of tourmaline-bearing rock in the northern part of the State were described in papers presented at professional meetings. Work on the geology of hydrothermal deposits at Faulkner Mountain in west-central South Carolina was ongoing during 1984. Other projects included radiometric age dating of selected rock units of the Piedmont and Blue Ridge, geologic mapping in western and central South Carolina, and preparation of a bulletin on seismic zones in the State.

The U.S. Department of Energy continued work on the construction of the $870 million Defense Waste Processing Facility at the Savannah River plant in Aiken, scheduled for completion in 1988. Upon completion, a process will be operated that will combine radioactive sludge from the Savannah River plant with borosilicate glass particles. The sludge-glass mixture will be heated into a liquid and poured into stainless steel canisters and allowed to solidify; ultimately the canisters will be transported to an underground repository.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

Industrial minerals comprised the bulk of mineral commodities mined and/or processed in the State. In 1984, as in past years, the principal nonmetallic mineral commodities, valuewise, mined in South Carolina were portland cement, stone, and clays (common clay and kaolin). These three minerals accounted for approximately 78% of the State's mineral value.

**Cement.**—South Carolina is one of the leading States in cement production in the Southeastern United States.

Table 4.—South Carolina: Cement industry in 1984

| Company | Location | Process | Number of kilns | Annual clinker capacity (thousand short tons) | Primary fuel |
|---|---|---|---|---|---|
| Giant Portland & Masonry Cement Co | Harleyville | Wet | 4 | 770 | Coal. |
| Gifford-Hill & Co. Inc | do | Dry | 1 | 550 | Do. |
| Santee Portland Cement Corp | Holly Hill | Wet | 2 | 1,060 | Do. |

All of the companies produced portland Types I and II, and Giant Portland & Masonry Cement Co. and Santee Portland Cement Corp. produced masonry cement. The three cement manufacturers operated mines in a Tertiary marl and in local clay deposits. Gypsum was obtained from Canada and the Caribbean area, and iron materials were shipped from other Southeastern States.

During 1984, Santee installed a feeder-breaker for clinker reclamation. Excess clinker is stored outdoors, and agglomeration results in pieces as large as 18 inches. Clinker is moved from storage to the feeder-breaker with a front-end loader and is then transported by belt conveyor to the milling operation.

Gifford-Hill & Co. Inc. completed modernization work on its existing preheater and dust collector. The program increased plant capacity.

Giant purchased the controlling interest in Keystone Portland Cement Co. in September. Giant acquired 6,000 Keystone common shares, giving it 51% of Keystone's outstanding shares. The company continued to use a waste oil from a polymer manufacturing process as an alternative fuel.[7]

**Clays.**—The clay industry in South Carolina consisted of 20 companies operating 36 mines in 16 counties producing kaolin, common clay and shale, and fuller's earth. Clay value, excluding that of fuller's earth, which is proprietary information, exceeded that reported in 1983 by almost $2 million; output increased 21,000 short tons.

Kaolin was produced by 8 companies operating 13 surface mines in 4 southwestern counties. Production exceeded that of 1983 by approximately 35,000 tons.

**Table 5.—South Carolina: Kaolin industry in 1984**

| County | Number | |
|---|---|---|
| | Companies | Mines |
| Aiken | 5 | 9 |
| Chesterfield | 1 | 1 |
| Lexington | 2 | 2 |
| Richland | 1 | 1 |

In kaolin production, stripping was by wheel scrapers and draglines, and mining was by power shovel; the kaolin was then transported by truck or pipeline. Processing was by airfloat or water-wash, depending on end use.

**Table 6.—South Carolina: Kaolin sold or used by producers, by kind and use**

(Short tons)

| Kind and use | 1983 | 1984 |
|---|---|---|
| Airfloat:[1] | | |
| Adhesives | 17,693 | 16,751 |
| Animal feed and pet waste absorbent | 1,269 | 6,844 |
| Ceramics[2] | 5,453 | 5,843 |
| Fertilizers, pesticides, and related products | 21,281 | 19,300 |
| Fiberglass | 100,099 | 82,149 |
| Paint | 1,671 | 365 |
| Paper coating and filling | 2,980 | 1,488 |
| Plastics | 14,804 | 12,351 |
| Rubber | 196,452 | 204,627 |
| Other refractories[3] | 4,157 | 9,318 |
| Other uses[4] | 106,914 | 108,514 |
| Exports[5] | 37,416 | 62,658 |
| Total | 510,189 | 530,208 |
| Unprocessed: Face brick and other uses not specified | 231,989 | 246,359 |
| Grand total | 742,178 | 776,567 |

[1] Includes water-washed.
[2] Includes floor and wall tile, pottery, and roofing granules.
[3] Includes refractory grogs and calcines; refractory mortar and cement; high-alumina refractories; and firebrick, blocks, and shapes.
[4] Includes animal oil, catalysts (oil-refining), chemical manufacturing, ink, medical, sewer pipe, and uses not specified.
[5] Includes ceramics, adhesives, paper filling, pesticides and related products, and rubber.

Common clay and shale production was reported by 14 companies operating 22 mines in the eastern, northern and central, and coastal plain areas of South Carolina.

### Table 7.—South Carolina: Common clay industry in 1984

| Area | Number | | Production | |
|---|---|---|---|---|
| | Companies | Mines | Quantity (thousand short tons) | Value (thousands) |
| Eastern[1] | 3 | 4 | 134 | $296 |
| Northern and Central[2] | 7 | 12 | 389 | 1,923 |
| Coastal Plain[3] | 6 | 6 | 534 | 1,186 |
| Total | 16 | 22 | 1,057 | 3,405 |

[1] Edgefield, Greenwood, and Saluda Counties.
[2] Cherokee, Kershaw, Lancaster, Lexington, and Richland Counties.
[3] Dorchester, Horry, Marion, Marlboro, and Orangeburg Counties.

Approximately 35% of the total clay output was used in brick manufacture.

Fuller's earth was mined by SCA Services in Sumter County. The company also operated an on-site chemical waste storage repository at the Sumter County mine.

**Colemanite.**—Industrial Minerals Inc. operated a custom grinding facility at Kings Creek in the northern part of the State. Colemanite, a calcium borate mineral, was imported from Turkey by fiberglass companies. The material entered South Carolina through the Port of Charleston and was shipped to Kings Creek by rail. After crushing, it was shipped to fiberglass manufacturers in South and North Carolina.

**Feldspar.**—A feldspar-silica concentrate, a byproduct of lithium ore beneficiation by Lithium Corp. of America Inc. (Lithcoa) at Cherryville, NC, was shipped to Pacolet for grinding. Sales were to the glass and whiteware industries and as a filler in some industrial applications.

**Mica.**—Spartan Minerals Corp. dry ground a mica concentrate recovered by Lithcoa in North Carolina during the beneficiation of lithium ore. Most of the ground material was sold to joint compound manufacturers.

Mineral Mining Corp. operated an open pit mine in a sericite schist in Lancaster County in the northern part of the State. The material was dry ground to produce a filler used primarily by the paint, joint cement, and electronics industries.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

The South Carolina sand and gravel industry, 36 companies operating 55 mines in a 23-county area, reported an increase in sales of $3.8 million above those estimated in 1983.

### Table 8.—South Carolina: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 2,897 | $8,732 | $3.01 |
| Plaster and gunite sands | 290 | 531 | 1.83 |
| Concrete products | 707 | 2,353 | 3.33 |
| Asphaltic concrete | 1,168 | 4,137 | 3.54 |
| Fill | 418 | 526 | 1.26 |
| Other[1] | 365 | 817 | 2.24 |
| Total or average | 5,845 | [2]17,097 | 2.93 |

[1] Includes other unspecified uses.
[2] Data do not add to total shown because of independent rounding.

*Industrial.*—South Carolina's industrial sand and gravel industry, located in Cherokee, Lexington, and Kershaw Counties, consisted of six companies operating six mines. Production rose 40,000 short tons and value increased $1.7 million above the 1983 levels. Principal markets, in descending order of tonnage, were fiberglass, molding, containers, sandblast media, and chemicals.

One industrial sand company shipped pebbles from a company-owned mine in Texas for use in the silica grinding process.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

In 1983, the industry consisted of 14 companies operating 27 quarries in 19 counties. The value of crushed stone production in 1984, based on a preliminary survey of major producers before yearend, increased $11.4 million over that of 1983; the value of dimension stone production fell $73,000.

**Vermiculite.**—W. R. Grace and Patterson Vermiculite Co. comprise the active producers in South Carolina. Moody Products Co. and Carolina Vermiculite Inc. held mining permits but were not active during the year.

Both W. R. Grace and Patterson Vermiculite have facilities in the Enoree District approximately 70 miles northwest of Columbia. W. R. Grace operated two exfoliation plants and Patterson operated one. W. R. Grace's sales were for lightweight aggregate applications, loose fill insulation, and horticultural applications; Patterson's output was used to produce horticultural products sold by the company.

## METALS

**Aluminum.**—Alumax Inc. in Berkeley County imported alumina from Australia through the Port of Charleston. The Alumax plant at Mount Holly, with an annual capacity of 181,000 metric tons, houses two potlines and produced billets, ingots, and slabs. In the latter part of the year, many U.S. aluminum producers closed potlines to curtail production and inventories as aluminum prices fell. Alumax cut back production by 13,000 metric tons at the Mount Holly plant as prices and demand fell and inventories increased. Despite the temporary shutdown, Alumax was considering a third potline for the Mount Holly plant.

**Copper.**—AT&T Nassau Metals Corp. operated a copper recycling facility at Gaston. The plant, constructed in the late 1970's, serves as headquarters for the corporation. In addition to its primary product, copper rod, the Gaston plant marketed a variety of byproducts obtained during the manufacturing process.

**Ferroalloys.**—Macalloy Inc. in Charleston is the only significant domestic producer of 50% to 55% charge chrome, the major grade used in steelmaking. In financial trouble from 1981 to 1983, the company was awarded its second U.S. General Services Administration contract worth $26 million. The company will convert 141,601 short tons of chrome ore into approximately 57,000 tons of high-carbon ferrochrome in 1985. The contract, part of a National Defense Stockpile program to improve stockpile readiness and help maintain a minimal level of domestic ferroalloy capacity, includes an option for a third year.

**Gold.**—Several companies were conducting exploration programs in South Carolina's Slate Belt. Two of them, Piedmont Mining and Amselco Minerals Inc., held current mining permits from the State.

At yearend, Piedmont Mining was constructing surface facilities, a leach pad, and associated ponds at the Haile Mine near Kershaw. Production was scheduled for early 1985.

Amselco, a Denver-based company and a subsidiary of the British Petroleum Co. PLC, maintained exploration offices and a sample preparation laboratory in Canada. The company was evaluating the gold potential of the Brewer Mine.

**Iron and Steel.**—Georgetown Steel Corp., Georgetown; Nucor Corp., Darlington; and Owen Electric Steel Co., Columbia, comprised the State's steel industry. The 3 companies operated 11 electric furnaces to produce a variety of metal shapes. In 1984, Georgetown Steel restarted the facility for direct reduction of iron from iron ore. This provided an alternative feed for Georgetown's minimill. The process was restarted because of higher scrap prices, a new contract for inexpensive natural gas, and the higher purity of direct-reduced iron compared to scrap.[8]

Nucor has been the world's most profitable producer of carbon steel. At yearend, Nucor was considering a pilot program to develop the technology to cast 1-1/2-inch-thick slabs. Current technology restricts minimill castings to a 6-inch slab, which requires too much steel for an electric furnace plant. In late December, Nucor was negotiating with two groups of process sponsors on an agreement to build a pilot plant.

**Manganese Ore.**—Three companies in Cherokee County mined zones containing from 5% to 15% manganese in the Battleground Schist. The material was ground, bagged, and sold to South and North Carolina brick manufacturers as a coloring agent.

**Zircon.**—M & T Chemicals Inc. operated a grinding plant in Andrew. Crude zircon concentrate, obtained as a byproduct in titanium mineral beneficiation, was imported from Australia and Florida. The Georgetown County plant produced a ground material used by the foundry, wall tile, whiteware, and ceramics industries.

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] Chief, Economic Geology Div., South Carolina Geological Survey, Columbia, SC.

[3] Daily Item (Sumter County). Modest Mining Operation Spawned 'SCA'. Dec. 10, 1984.

[4] News (Greenville). State Becomes Garbage Dump for Nation. Oct. 21, 1984.

———. Is Landfill for Toxic Waste Safe, or a Timebomb in the Ground? Oct. 22, 1984.

———. Fighting Uncle Sam—and Losing Big. Oct. 23, 1984.

[5] ———. Governor To Change Waste Burial Practices. Oct. 23, 1984.

[6] Daily Item (Sumter County). Industrial Bonds Depend on Commitment To Buy. Apr. 11, 1984.

[7] Rock Products. Apr. 1984, p. 44.

[8] Iron Age. Mar. 1, 1985, p. 29.

## Table 9.—South Carolina: Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum smelters: | | | |
| Alumax Inc | Box 1000<br>Goose Creek, SC 29445 | Plant | Berkeley. |
| Cement: | | | |
| Giant Portland & Masonry Cement Co | Box 218<br>Harleyville, SC 29448 | do | Dorchester. |
| Gifford-Hill & Co. Inc | Box 326<br>Harleyville, SC 29448 | do | Do. |
| Santee Portland Cement Corp | Box 698<br>Holly Hill, SC 29059 | do | Orangeburg. |
| Clays: | | | |
| Common clay and shale: | | | |
| Gifford-Hill & Co. Inc | Box 326<br>Harleyville, SC 29448 | Mines | Dorchester. |
| Palmetto Brick Co.[1] | Box 430<br>Cheraw, SC 29520 | do | Marlboro and Chesterfield. |
| Richtex Corp.[1] | Box 3307<br>Columbia, SC 29230 | do | Lexington and Richland. |
| Santee Portland Cement Corp | Box 698<br>Holly Hill, SC 29059 | do | Orangeburg. |
| Southern Brick Co | Box 208<br>Ninety Six, SC 29666 | do | Greenwood, Newberry, Saluda. |
| Fuller's earth: | | | |
| SCA Services Inc | Route 1, Box 255<br>Pinewood, SC 29125 | Mine and plant | Sumter. |
| Kaolin: | | | |
| Dixie Clay Co | Box B<br>Bath, SC 29816 | do | Aiken. |
| J. M. Huber Corp | Box 306<br>Langley, SC 29834 | do | Do. |
| Colemanite: | | | |
| Industrial Minerals Inc | Box 459<br>York, SC 29745 | Plant | York. |
| Spartan Minerals Corp., a division of Lithium Corp. of America. | Box 520<br>Pacolet, SC 29372 | do | Spartanburg. |
| Manganiferous ore: | | | |
| Ashe Brick Co | Van Wyck, SC 29744 | Plants | Cherokee and Spartanburg. |
| Broad River Brick Co., a division of Boren Clay Products. | Box 368<br>Pleasant Garden, NC 27313 | do | Do. |
| Fletcher Brick Co., a division of Moland-Drysdale Corp. | Box 2150<br>Hendersonville, NC 28739 | do | Do. |
| Mica (sericite): | | | |
| Mineral Mining Corp | Box 458<br>Kershaw, SC 29067 | Mine and plant | Lancaster. |
| Sand and gravel (construction): | | | |
| Becker Sand and Gravel Co. Inc | Box 848<br>Cheraw, SC 29520 | Pits and plants | Chesterfield, Dorchester, Florence, Marlboro, Sumter. |
| Brewer Sand Co. Inc | Box 267<br>Lancaster, SC 29720 | Pit and plant | Lancaster. |
| Foster-Dixiana Sand Co | Box 5447<br>Columbia, SC 29250 | do | Lexington and Richland. |

See footnotes at end of table.

**Table 9.—South Carolina: Principal producers —Continued**

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Stone: | | | |
| Granite (crushed and broken): | | | |
| Lone Star Industries Inc | Box 420<br>Norfolk, VA 23501 | Quarry and plant | Fairfield, Greenwood, Richland. |
| Martin Marietta Aggregates | Box 30013<br>Raleigh, NC 27612 | do | Fairfield, Lexington, Richland, York. |
| Vulcan Materials Co | Drawer 8834<br>Greenville, SC 29604 | do | Greenville, Laurens, Pickens, Spartanburg. |
| Granite (dimension): | | | |
| Granite Panelwall Co., a division of Florida Crushed Stone. | Box 898<br>Elberton, GA 30635 | Quarry | Kershaw. |
| Matthews International Corp | Box 606<br>Kershaw, SC 29067 | do | Do. |
| Limestone (crushed): | | | |
| Martin Marietta Aggregates | Box 30013<br>Raleigh, NC 27612 | Quarry and plant | Berkeley and Georgetown. |
| Southern Aggregates Co | Box 338<br>Taylors, SC 29687 | Quarry | Berkeley. |
| Vulcan Materials Co | Drawer 8834<br>Greenville, SC 29604 | Quarry and plant | Cherokee. |
| Marl (crushed): | | | |
| Giant Portland & Masonry Cement Co. | Box 21969<br>Columbia, SC 29221 | Pit | Dorchester. |
| Gifford-Hill & Co. Inc | Box 326<br>Harleyville, SC 29448 | Pit | Do. |
| Santee Portland Cement Corp | Box 698<br>Holly Hill, SC 29059 | Pit | Orangeburg. |
| Vermiculite: | | | |
| W. R. Grace & Co | Route 1<br>Enoree, SC 29335 | Mine and plant | Laurens. |
| Patterson Vermiculite Co | do | do | Do. |

[1] Also kaolin.

# The Mineral Industry of South Dakota

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota Geological Survey for collecting information on all nonfuel minerals.**

### By James H. Aase[1] and Wanda J. West[2]

The value of nonfuel mineral production in South Dakota during 1984 was valued at $193.4 million, a decrease of 13% from that of 1983 but 27% above the 10-year average. The decrease was primarily a result of lower gold prices.

South Dakota ranked 34th nationally in 1984 for the value of its nonfuel mineral production, accounting for about 1% of the U.S. total. During 1984, 5 of the 14 mineral commodities produced in the State recorded increases in total sales value and 6 recorded production gains over those of 1983. Gold, the leading commodity produced in terms of value during 1984, contributed 58% of the State's total mineral value. Cement was the value leader among the industrial minerals produced, followed by dimension and crushed stone, collectively accounting for 32% of the State total.

Table 1.—Nonfuel mineral production in South Dakota[1]

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Cement: | | | | |
| Masonry ---------- thousand short tons -- | 4 | $359 | 5 | $283 |
| Portland ---------- do ---- | 603 | 37,435 | 619 | 30,773 |
| Clays[2] ---------- do ---- | 123 | 353 | 119 | 343 |
| Feldspar ---------- short tons -- | 7,109 | 107 | 7,219 | 124 |
| Gem stones ---------- | NA | 70 | NA | 70 |
| Gold (recoverable content of ores, etc.) ---------- troy ounces -- | 309,784 | 131,348 | 310,527 | 111,994 |
| Sand and gravel (construction) ---------- thousand short tons -- | [e]5,100 | [e]11,500 | 5,786 | 12,168 |
| Silver (recoverable content of ores, etc.) -- thousand troy ounces -- | 62 | 713 | 50 | 407 |
| Stone: | | | | |
| Crushed ---------- thousand short tons -- | 3,906 | 12,982 | [e]3,800 | [e]12,800 |
| Dimension ---------- do ---- | [r]42 | [r]15,794 | [e]60 | [e]18,642 |
| Combined value of beryllium, clays (bentonite), gypsum, lime, and mica (scrap) ---------- | XX | 11,432 | XX | 5,803 |
| Total ---------- | XX | [r]222,093 | XX | 193,407 |

[e]Estimated. [r]Revised. NA Not available. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes bentonite; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in South Dakota, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Beadle | $23 | (2) | |
| Bon Homme | 35 | (2) | |
| Brookings | W | (2) | |
| Brown | 182 | (2) | |
| Butte | W | W | Clays. |
| Campbell | W | (2) | |
| Charles Mix | 156 | (2) | |
| Clark | 75 | (2) | |
| Clay | 30 | (2) | |
| Codington | W | (2) | |
| Corson | 10 | (2) | |
| Custer | 298 | $1,228 | Stone (crushed), mica, feldspar, beryllium. |
| Davison | W | (2) | |
| Day | 89 | (2) | |
| Deuel | 204 | (2) | |
| Dewey | 49 | (2) | |
| Douglas | W | (2) | |
| Fall River | 181 | W | Stone (crushed). |
| Faulk | 33 | (2) | |
| Grant | W | 15,794 | Stone (dimension). |
| Gregory | 142 | (2) | |
| Haakon | 16 | (2) | |
| Hamlin | 40 | (2) | |
| Hand | W | (2) | |
| Hanson | 3 | W | Stone (crushed). |
| Harding | 40 | (2) | |
| Hughes | 9 | (2) | |
| Hutchinson | W | (2) | |
| Hyde | 100 | (2) | |
| Jerauld | 31 | (2) | |
| Jones | 90 | (2) | |
| Lake | 317 | (2) | |
| Lawrence | W | 132,431 | Gold, silver, stone (crushed). |
| McPherson | W | (2) | |
| Marshall | W | (2) | |
| Meade | 1,165 | (2) | |
| Miner | W | (2) | |
| Minnehaha | 516 | 4,129 | Stone (crushed). |
| Moody | W | (2) | |
| Pennington | 33,404 | W | Cement, stone (crushed), lime, clays, gypsum. |
| Perkins | W | (2) | |
| Roberts | 292 | (2) | |
| Sanborn | W | (2) | |
| Spink | W | (2) | |
| Sully | 509 | (2) | |
| Turner | W | (2) | |
| Union | 76 | (2) | |
| Walworth | 55 | (2) | |
| Yankton | 203 | W | Stone (crushed). |
| Undistributed[3] | 73,626 | 57,010 | |
| Sand and gravel (construction) | XX | [e]11,500 | |
| Stone: | | | |
| Crushed | [e]7,400 | XX | |
| Dimension | [r] [e]14,805 | XX | |
| Total[4] | [r]134,208 | 222,093 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Includes gem stones and sand and gravel (construction,1982) that cannot be assigned to specific counties and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of South Dakota business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 694 | 699 | 706 |
| Total civilian labor force | do | 330 | 334 | 346 |
| Unemployment | do | 18 | 18 | 15 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 2.3 | 2.7 | 2.7 |
| Metal mining[2] | do | 1.3 | 1.6 | NA |
| Nonmetallic minerals except fuels[2] | do | .9 | .9 | NA |
| Oil and gas extraction[2] | do | .2 | .1 | NA |
| Manufacturing total | do | 24.8 | 25.9 | 28.6 |
| Primary metal industries[2] | do | .2 | .2 | NA |
| Stone, clay, and glass products[2] | do | 1.0 | 1.1 | NA |
| Chemicals and allied products[2] | do | .2 | .2 | NA |
| Construction | do | 8.2 | 8.4 | 8.9 |
| Transportation and public utilities | do | 12.5 | 12.3 | 12.0 |
| Wholesale and retail trade | do | 61.9 | 62.5 | 64.5 |
| Finance, insurance, real estate | do | 11.8 | 12.4 | 13.1 |
| Services | do | 52.0 | 54.2 | 58.0 |
| Government and government enterprises | do | 56.6 | 56.9 | 57.0 |
| Total[3] | do | 230.2 | 235.3 | 244.6 |
| Personal income: | | | | |
| Total | millions | $6,532 | $6,843 | $7,813 |
| Per capita | | $9,407 | $9,794 | $11,069 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 41.1 | 41.6 | 42.4 |
| Total average hourly earnings, production workers | | $7.36 | $7.31 | $7.15 |
| Earnings by industry: | | | | |
| Farm income | millions | $518 | $549 | $944 |
| Nonfarm | do | $3,688 | $3,963 | $4,307 |
| Mining total | do | $66 | $74 | $80 |
| Metal mining | do | $43 | $50 | $54 |
| Nonmetallic minerals except fuels | do | $18 | $20 | $21 |
| Oil and gas extraction | do | $5 | $4 | $5 |
| Manufacturing total | do | $460 | $500 | $557 |
| Primary metal industries | do | $3 | $5 | $5 |
| Stone, clay, and glass products | do | $20 | $21 | $24 |
| Chemicals and allied products | do | $5 | $4 | $4 |
| Construction | do | $190 | $211 | $245 |
| Transportation and public utilities | do | $334 | $346 | $363 |
| Wholesale and retail trade | do | $781 | $817 | $888 |
| Finance, insurance, real estate | do | $214 | $246 | $274 |
| Services | do | $763 | $843 | $925 |
| Government and government enterprises | do | $855 | $902 | $949 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 1,220 | 2,501 | 3,534 |
| Value of nonresidential construction | millions | $77.8 | $103.1 | $104.3 |
| Value of State road contract awards | do | $78.0 | $85.4 | $101.3 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 197 | 278 | 228 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $134.2 | $222.1 | $193.4 |
| Value per capita | | $194 | $317 | $274 |

[p] Preliminary. [r] Revised. NA Not available.

[1] South Dakota Department of Labor mining totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

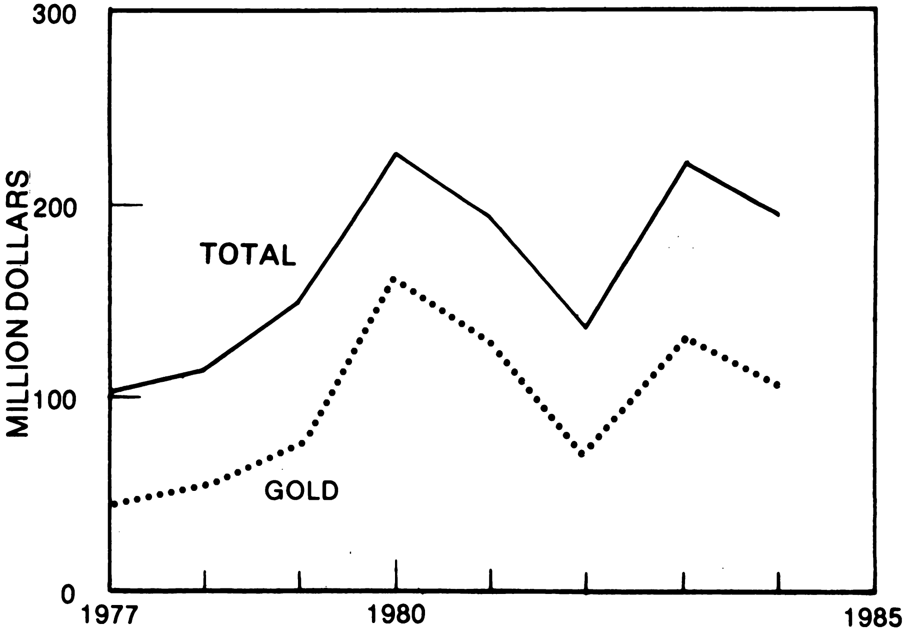

Figure 1.—Value of mine production of gold and total value of nonfuel mineral production in South Dakota.

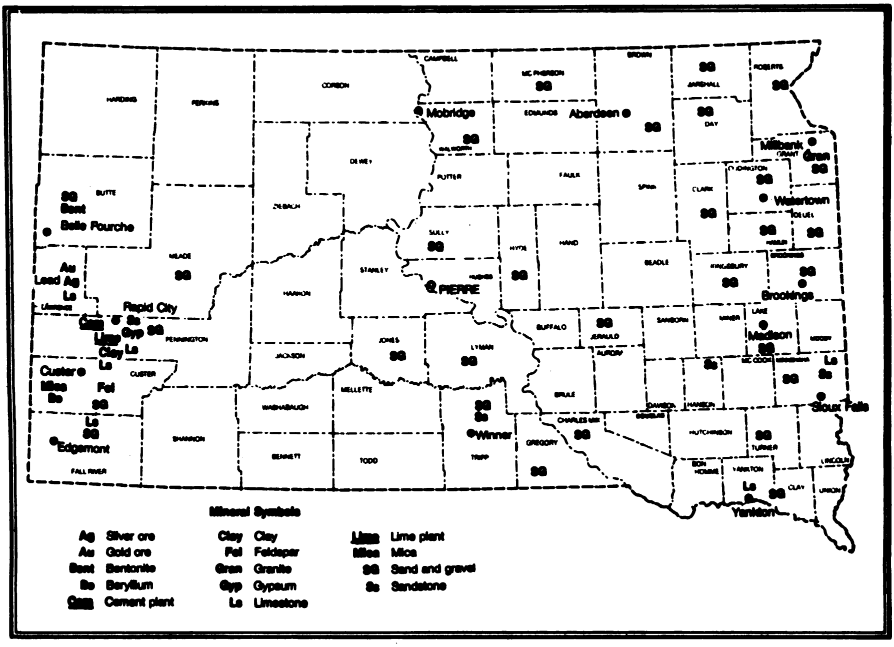

Figure 2.—Principal mineral producing localities in South Dakota.

Among the minerals produced in 1984, the quantity of gold South Dakota produced ranked second among 12 States; mica, second of 8; beryllium, second of 2; and dimension stone, fifth of 32.

**Employment.**—Figures from the South Dakota Department of Labor, Research and Statistics Division, indicated average employment in the mining industry during 1984 totaled 2,706 workers, a 2% increase compared with that of 1983. Mining industry workers represented about 1% of the State's total nonagricultural work force. During 1984, those engaged in mining received average weekly earnings of $482.71, a 4% increase over that received in 1983.

**Trends and Developments.**—Exploration activities directed toward the search for nonfuel minerals, excluding aggregates, dropped slightly from the 1983 level. During 1984, the State issued 15 nonfuel mineral exploration permits, all indicating "gold," "silver," or "precious metals" as the principal commodity being sought. In addition, the State issued 12 mining permits for nonfuel mineral commodities, including 6 for gold or precious metals in Custer, Lawrence, and Pennington Counties; 1 for gypsum in Pennington County; and 5 for pegmatite minerals in Custer and Pennington Counties.

Near midyear, Homestake Mining Co. announced plans to commence development of its Ragged Top gold property near Savoy in Lawrence County. The property reportedly contains nearly 900,000 short tons of ore that will be mined by open pit methods at a rate of 15,000 tons per month during peak activity. The ore will be crushed on-site and transported to the company's existing mill at Lead for final processing.

During 1984, the State granted permission to Wharf Resources (USA) Inc. to increase ore-waste production from 500,000 to 800,000 tons per year at its Annie Creek gold property west of Lead. A new pumping system, intended to allow the leaching process to proceed uninterrupted throughout the year, was installed at the site. Heavy rains forced a temporary shutdown of the leaching operation to avoid exceeding the holding capacity of leachate ponds containing cyanide solution. Annie Creek is South Dakota's only commercial gold heap leaching operation, and 1984 marked its first full year of operation.

Viable Resources Inc. and St. Joe American Corp., a subsidiary of the Fluor Corp., consummated a joint venture agreement to continue exploration and development activities on Viable's Carbonate mining properties in Lawrence County. As the result of work previously performed on the site, the presence of gold and silver has been established through 35,000 geochemical assays and the drilling of 55 holes. Reportedly, metallurgical tests indicated economic quantities of gold may be recovered by heap leaching the low-grade ore.

In August, a new $10 million state-of-the-art, biological waste water treatment plant began operation at Homestake's gold mine in Lead. The new facilities and processes were for removal of solid wastes from discharged process wastes.

Lacana Mining Corp. of Toronto, Ontario, Canada, reported that preliminary work it conducted at the Gilt Edge property near Lead indicated proven and probable ore reserves of 5.7 million tons, grading 0.057 ounce of gold per ton. Large-scale metallurgical testing was in progress at yearend.

**Legislation and Government Programs.**—Among the bills the 1984 State Legislature enacted that related to the mining industry and the mineral resources of the State were the following:

Senate Bill 2, "Reduction of Precious Metals Severance Tax Rate," reduced the severance tax on precious metals from 6% to 2% and imposed an 8% tax on net profits.

House Bill (HB) 1066, "Environmental Laws," amended certain environmental laws, including violation of effluent standards, pollution of any State waters, regulation of generation, transportation, treatment, storage, and disposal of hazardous wastes.

HB 1107, "Damage Caused by Mineral Development," permits the commissioner of school and public lands to adjust lease rental to compensate for loss of land use owing to mineral development on school and public lands.

HB 1241, "Taxation of Severed Mineral Interests," provides for the equalization of the assessment and payment of property taxes if mineral interest has been severed.

In fiscal year 1984, the State of South Dakota received nearly $1.7 million from the U.S. Department of the Interior as compensation for the fiscal impacts caused by the presence of certain tax-exempt Federal lands within its boundaries. These payments are in addition to the $891,000 paid to the State during fiscal year 1984 from mineral leasing, rents, royalties, and bonuses collected from Federal lands by the U.S. Government and shared with State governments.

Under provisions of "Title III—State Mining and Mineral Resources and Research Institutes" of the Surface Mining Control and Reclamation Act of 1977, Public law 95-87, the South Dakota School of Mines and Technology at Rapid City received a grant from the U.S. Bureau of Mines. The grant, to be matched with non-Federal funds, was intended in part to encourage graduate-level research on national and regional problems in mineral engineering, to train qualified mineral scientists and engineers, and to facilitate industry, State, and Federal cooperation in solving mineral engineering problems.

During 1984, as in 1983, the South Dakota Geological Survey (SDGS) put a major emphasis on research connected with its water resource programs. SDGS was in the final stages of a series of special water supply studies of the entire State for the U.S. Army Corps of Engineers and was completing water quality studies of selected aquifers in cooperation with the U.S. Environmental Protection Agency. All basic data from these programs, together with 11,500 drilling records, 2,497 water quality records, and over 101,000 water level measurements, were entered into a computerized data-management system for readily available retrieval for interested researchers and other users.

During the year, SDGS started an investigation to determine the hydrogeology of glacial till. Understanding water movement through glacial till will have a significant impact on the development and management of water from buried aquifers and on irrigation practices of glacial till land in the State.

An ongoing program to do geologic-hydrologic study for each county in eastern South Dakota was continued in 1984 by SDGS. Under the program, which was started 20 years ago in cooperation with the U.S. Geological Survey, 38 studies have been completed or are under way. In 1983, the project expanded to incorporate a total geologic and hydrologic investigation of the entire Big Sioux Basin. This project will bring together all aspects of research within the basin; the ultimate result being a computerized ground water model allowing optimum development of the water resources through proper management.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

**Beryllium.**—Pacer Corp. reported a small amount of hand-cobbed beryl production in Custer County. The quantity and value of the entire State output in 1984 was less than one-half of that for 1983. The average 1984 price for material marketed was nearly 30% below that of 1983.

**Gold.**—South Dakota ranked second behind Nevada among the 12 States reporting gold production in 1984. Output increased slightly over that of 1983 and was 10% above the 10-year average. Total value decreased, however, owing to a $63 per troy ounce decline in the average price compared with 1983 figures. A contributing factor to the price slump was the increasing strength of the U.S. dollar in world markets, which had the effect of weakening metal prices.

**Table 4.—South Dakota: Mine production of gold and silver in terms of recoverable metal**

| Year | Mines producing | | Material sold or treated[1] (thousand metric tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Troy ounces | Value (thousands) | Thousand troy ounces | Value (thousands) |
| 1980 | 1 | 1 | 1,621 | 267,642 | $163,947 | 51 | $1,058 |
| 1981 | 1 | 1 | 1,677 | 278,162 | 127,854 | 56 | 587 |
| 1982 | 1 | -- | 1,059 | 185,038 | 69,558 | 26 | 209 |
| 1983 | 2 | -- | 1,771 | 309,784 | 131,348 | 62 | 713 |
| 1984 | 2 | -- | 2,252 | 310,527 | 111,994 | 50 | 407 |
| 1876-1984 | NA | NA | NA | 38,614,082 | 1,990,011 | 13,643 | 15,930 |

NA Not available.

[1] Excludes placer gravel.

Homestake's underground mine and opencut test site at Lead and Wharf Resources's open pit mine near Terry Peak, west of Lead, accounted for the State's entire gold production. Of the 2.5 million tons of gold ore mined and processed in the State during 1984, the average recovery of gold was approximately 0.13 troy ounce per ton of material treated.

Homestake's 1984 annual report indicated that gold ore reserves at its underground mine were 19,267,000 tons at an average grade of 0.220 ounce per ton. Production at the Homestake Mine dropped 3.8% below the 1983 level. The average cost of production increased to $324 per ounce, compared with $301 in 1983. During 1984, the average grade of ore mined dropped 9.8% from that mined in 1983. This was a major contributor to the higher per-ounce production cost.

Mining and exploration work continued in the deep levels of the Homestake Mine below the 6,800-foot level. The new 7,550-foot level was begun, and preparation of the 6,950-foot level hoist station was initiated as part of the program to extend the No. 4 internal shaft from the 6,800-foot level to the 7,400-foot level.

Production began at Homestake's opencut test site in June after removal of approximately 2 million tons of waste rock and low-grade ore. Surface gold ore production totaled 202,000 tons at an average grade of 0.054 ounce per ton. Total gold recovered from the opencut was 10,958 troy ounces, with a mill recovery of 88%. Test mining will continue through the fall of 1985. Removal of approximately 4 million tons of waste rock and 500,000 tons of ore is planned. Evaluation of test results will determine the feasibility of commercial production at the opencut.

**Silver.**—Compared with 1983 figures, silver production, all obtained as a coproduct with gold produced at the Homestake Mine in Lead, decreased 19% in quantity and 43% in value. The average price of silver dropped to $8.14 per troy ounce in 1984, $3.30 per troy ounce less than in 1983.

## NONMETALS

**Cement.**—The State-owned cement plant in Rapid City was the sole source of cement manufactured in South Dakota. Output for the year increased 3% in quantity but declined 18% in value compared with that of 1983 and consisted of various types of portland cement and a prepared masonry cement. The average unit value of the portland and masonry cement sold in 1984 was $49.73 per short ton and $57.01 per short ton, respectively.

The cement plant is the second largest source of State revenue, after sales taxes. In the last 3 State fiscal years, the cement plant has made a profit of $26 million and transferred $22 million to the State general fund. During 1984, the plant earned a profit of $12.8 million.

With a rated clinker production capacity of about 1 million short tons per year, the plant operated at about 51% capacity for the year. Approximately 900,000 tons of mostly State-produced nonfuel materials, including clay and shale, gypsum, iron ore, limestone, and sand, were consumed in manufacturing the cement.

Ready-mix companies were the largest users of the portland cement manufactured, using approximately 48% of the 1984 output. Shipments of portland cement from the plant were handled 90% by truck, and the remainder, by rail. Nearly 97% of these shipments was in bulk form.

**Clays.**—Crude bentonite, mined from pits both within the State and out of State, was processed at American Colloid Co.'s plant near Belle Fourche in Butte County. The quantity and value of the processed material marketed during 1984 decreased sharply from the levels of 1983, and declines were reported in all use categories. The output was sold for nearly 2 dozen diverse uses, with drilling muds, foundry sand, and animal feed consuming the greatest amounts.

Common clay and shale was mined in Pennington County by the South Dakota Cement Commission for its use in manufacturing cement at its State-owned plant in Rapid City. The quantity of the common clay and shale produced in 1984 decreased 3% from that of 1983 and was 25% below the 10-year average. The unit value of the common clay produced increased to a record high of $2.88 per ton.

**Feldspar.**—Hand-cobbed feldspar, obtained from several small mines in Custer County, was processed at a grinding mill operated by Pacer at Custer. The quantity of crude ore mined remained relatively unchanged from that of 1983. An advance of $2.15 per ton in the average unit price of the crude during 1984 resulted in an increase of 16% in the total value for the year's output over that of 1983. The processed material was marketed principally for use in pottery with lesser amounts used in ceramic insulators. The ground material was shipped to more than a dozen States and abroad.

**Gem Stones.**—No commercial gem stone mining operations were reported in South Dakota during 1984. The value shown in table 1 of this chapter represents an estimate for material collected by rockhounds and other hobbyists.

**Gypsum.**—The sole source of gypsum mined in the State was at a site in Pennington County operated by the South Dakota Cement Commission. The crude material produced was used exclusively in manufacturing cement at the State-owned cement plant in Rapid City. The quantity of material mined during 1984 increased 4% over that of 1983.

**Lime.**—Pete Lien & Sons Inc., the only producer of lime in the State, produced hydrated lime and quicklime at a plant in Rapid City. Lime output during the year decreased slightly in quantity compared with that of 1983, but a 4% increase in the average unit price resulted in an increase in total value. Among the principal uses of the marketed product were road and soil stabilization, sulfur removal from stack gases, and basic oxygen furnace steel.

In 1984, consumption of lime in South Dakota, obtained from all domestic sources, was approximately 21,000 short tons.

**Mica.**—Pacer accounted for the State's entire output in 1984. The material marketed was processed at the company's grinding mill in Custer. The quantity, value, and average unit price of the mica marketed remained at approximately the same level as recorded in 1983.

**Sand and Gravel (Construction).**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

In 1984, production of construction sand and gravel, the leading commodity produced in the State in terms of quantity, rose modestly over levels estimated for 1983. The average unit value for construction sand and gravel was $2.10 per net ton, a decrease of 7% from that marketed in 1983.

Output during the year was recorded for 106 firms and government agencies operating at 183 sites throughout 50 of the State's 66 counties. Minnehaha County was the leader in production, followed by Brookings, Jerauld, Codington, and Day Counties, each recording production in excess of 250,000 tons and collectively accounting for 35% of the State total.

**Table 5.—South Dakota: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 557 | $2,305 | $4.14 |
| Plaster and gunite sands | W | W | 5.00 |
| Concrete products | W | W | 1.37 |
| Asphaltic concrete | 374 | 979 | 2.62 |
| Road base and coverings[1] | 2,634 | 4,182 | 1.59 |
| Fill | 200 | 227 | 1.13 |
| Snow and ice control | 21 | 37 | 1.82 |
| Railroad ballast | 3 | 3 | 1.00 |
| Other | 1,998 | 4,434 | 2.22 |
| Total[2] or average | 5,786 | 12,168 | 2.10 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes road and other stabilization (lime).

[2] Data may not add to totals shown because of independent rounding.

### Table 6.—South Dakota: Construction sand and gravel sold or used by producers, by county

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Beadle | 1 | 23 | $23 | 1 | 30 | $59 |
| Bon Homme | 1 | 33 | 35 | -- | -- | -- |
| Brookings | 1 | W | W | 5 | 505 | 1,184 |
| Brown | 2 | 70 | 182 | 2 | 57 | 161 |
| Butte | 1 | 24 | 36 | 2 | W | 130 |
| Campbell | 2 | W | W | 2 | 35 | 162 |
| Charles Mix | 3 | 79 | 156 | 4 | 182 | 373 |
| Clark | 1 | 54 | 75 | 10 | 68 | 71 |
| Clay | 1 | 23 | 30 | -- | -- | -- |
| Codington | 3 | W | W | 5 | 294 | 817 |
| Corson | -- | 5 | 10 | 2 | 30 | 30 |
| Custer | -- | -- | -- | 10 | 118 | 260 |
| Day | 1 | 48 | 89 | 7 | 286 | 316 |
| Deuel | 3 | 94 | 204 | 9 | 86 | 173 |
| Dewey | 1 | 26 | 49 | -- | -- | -- |
| Douglas | 1 | W | W | 2 | 35 | W |
| Fall River | 2 | 39 | 181 | 1 | 103 | 449 |
| Faulk | 1 | 19 | 33 | 1 | 35 | 35 |
| Grant | 2 | W | W | 9 | 188 | 259 |
| Gregory | 4 | 81 | 142 | 5 | 191 | 315 |
| Haakon | 1 | 9 | 16 | -- | -- | -- |
| Hamlin | 3 | 37 | 40 | 3 | 58 | 67 |
| Hand | 2 | W | W | -- | -- | -- |
| Hanson | 2 | 3 | 3 | 2 | 25 | 25 |
| Harding | 2 | 40 | 40 | 1 | 46 | 46 |
| Hughes | 1 | 3 | 9 | 4 | 35 | 44 |
| Hutchinson | 5 | W | W | 1 | 33 | 51 |
| Hyde | 3 | 54 | 100 | 1 | 54 | 128 |
| Jerauld | 3 | 22 | 31 | 8 | 387 | 864 |
| Jones | 1 | 70 | 90 | 1 | 60 | 113 |
| Lake | 2 | 93 | 317 | 5 | W | 305 |
| Lawrence | -- | W | W | 1 | 29 | 58 |
| Lyman | -- | -- | -- | 1 | 55 | 73 |
| McPherson | 2 | W | W | 7 | 211 | 260 |
| Marshall | 2 | W | W | 2 | W | 387 |
| Meade | 5 | 517 | 1,165 | 2 | W | W |
| Miner | 2 | W | W | 2 | 37 | 37 |
| Minnehaha | 6 | 331 | 516 | 9 | 565 | 935 |
| Pennington | 5 | 270 | 963 | 5 | 261 | 999 |
| Roberts | 9 | 120 | 292 | 13 | 223 | 581 |
| Sanborn | -- | W | W | 1 | 15 | 30 |
| Sully | 1 | 80 | 509 | 1 | 68 | 284 |
| Turner | 2 | W | W | 6 | 245 | 462 |
| Union | 3 | 68 | 76 | 3 | 40 | 47 |
| Walworth | 1 | 37 | 55 | 2 | 77 | 99 |
| Yankton | 4 | 94 | 203 | 6 | 176 | 343 |
| Ziebach | -- | -- | -- | 1 | 33 | 67 |
| Undistributed[1] | [r]10 | 1,350 | 2,931 | 18 | 809 | 1,071 |
| Total[2] | 108 | 3,816 | 8,604 | 183 | 5,786 | 12,168 |

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Brule (1984), Davison, Edmunds (1984), Kingsbury (1984), Moody, Perkins, Spink, and Tripp (1984) Counties, sand and gravel that cannot be assigned to specific counties (1982), and data indicated by symbol W.

[2] Data may not add to totals because of independent rounding.

In 1984, sand and gravel output was predominantly used for road base and coverings and stabilization purposes accounting for approximately 46% of the total. Other uses, in descending order of amount consumed, were for concrete aggregate, asphaltic concrete, fill, railroad ballast, and other miscellaneous uses.

Nearly 99% of the construction sand and gravel produced during the year was shipped by truck; virtually all of the remainder was shipped by rail or was not transported.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—The estimated quantity of crushed stone produced during 1984 decreased approximately 3% in quantity and 1% in value compared with that of 1983. The average unit price for the material marketed was estimated at $3.37 per short ton.

*Dimension.*—The estimated output of dimension stone during 1984 increased both in quantity and value over that of 1983 by 43% and 18%, respectively. Granite accounted for the bulk of the production, which was marketed principally as cut stone. South Dakota ranked fifth among the 32 States for which dimension stone production was estimated.

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[2] Editorial assistant, Bureau of Mines, Minneapolis, MN.

### Table 7.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Beryllium concentrate: | | | |
| Pacer Corp | Box 912<br>Custer, SD 57730 | Mine and plant | Custer. |
| Cement: | | | |
| South Dakota Cement Commission. | Box 360<br>Rapid City, SD 57709 | 4 rotary kilns | Pennington. |
| Clays: | | | |
| American Colloid Co | 5100 Suffield Ct.<br>Skokie, IL 60076 | Open pit mine and plant | Butte. |
| South Dakota Cement Commission. | Box 360<br>Rapid City, SD 57709 | Open pit mine | Pennington. |
| Feldspar: | | | |
| Pacer Corp | Box 912<br>Custer, SD 57730 | Open pit mines and dry-grinding plant. | Custer. |
| Gold: | | | |
| Homestake Mining Co | Box 875<br>Lead, SD 57754 | Underground mine, cyanidation mill, refinery. | Lawrence. |
| Wharf Resources (USA) Inc | Box 897<br>Lead, SD 57754 | Open pit mine and heap leaching. | Do. |
| Gypsum: | | | |
| South Dakota Cement Commission. | Box 360<br>Rapid City, SD 57709 | Open pit mine | Pennington. |
| Lime: | | | |
| Pete Lien & Sons Inc | Box 440<br>Rapid City, SD 57709 | 1 rotary kiln, 1 vertical kiln, continuous-hydrator plant. | Do. |
| Mica: | | | |
| Pacer Corp | Box 912<br>Custer, SD 57730 | Mine and dry-grinding plant. | Custer. |
| Sand and gravel (construction): | | | |
| W. E. Bartholow & Son Construction Co. | Route 3<br>Huron, SD 57350 | Pits and plants | Jerauld. |
| Birdsall Sand & Gravel Co. Inc | Box 767<br>Rapid City, SD 57709 | do | Fall River, Pennington, Sully. |
| Bowes Construction Inc | Box 451<br>Brookings, SD 57006 | do | Brookings. |
| Fisher Sand & Gravel Co | Box 1034<br>Dickinson, ND 58601 | do | Pennington, Roberts, Tripp, Ziebach. |
| Myrl & Roy's Paving Inc | 1500 East 39th St. North<br>Sioux Falls, SD 57101 | Pit and plant | Minnehaha. |
| Rechnagel Construction Co | Hurley, SD 57036 | Pits and plants | Turner. |
| Sweetman Construction Inc | 100 South Dakota Ave.<br>Summit, SD 57266 | do | Minnehaha and Roberts. |
| Silver: | | | |
| Homestake Mining Co | Box 875<br>Lead, SD 57754 | See "*Gold*" | Lawrence. |
| Stone (1983): | | | |
| Crushed: | | | |
| Limestone: | | | |
| Pete Lien & Sons Inc | Box 440<br>Rapid City, SD 57709 | Quarries and plants | Custer and Pennington. |
| Northwestern Engineering Co. (Hills Materials Co.). | Box 2320<br>Rapid City, SD 57709 | do | Fall River and Pennington. |
| South Dakota Cement Commission. | Box 360<br>Rapid City, SD 57709 | Quarry and plant | Pennington. |
| Sandstone-quartzite: | | | |
| Concrete Materials Co | Box 809<br>Sioux Falls, SD 57101 | do | Minnehaha. |
| L. G. Everist Inc | 313 South Phillips<br>Sioux Falls, SD 57101 | do | Do. |
| Spencer Quarries Inc | Box 25<br>Spencer, SD 57374 | do | Hanson. |
| Dimension: | | | |
| Granite: | | | |
| Cold Spring Granite Co | 202 South 3d Ave.<br>Cold Spring, MN 56320 | Quarries | Grant. |
| Dakota Granite Co | Box 1351<br>Milbank, SD 57252 | do | Do. |

# The Mineral Industry of Tennessee

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Tennessee Division of Geology for collecting information on all nonfuel minerals.**

**By Doss H. White, Jr.,[1] and Ray Gilbert[2]**

The value of Tennessee's nonfuel mineral production in 1984 rose to a record high $478.3 million, exceeding the previous record established in 1983 by $71 million. The State ranked 17th in the Nation in mineral production and 8th in the Eastern United States.

The increase in mineral sales during 1984 was primarily due to strong demands by the construction industry for raw materials. Sales of clays, sand and gravel, and stone increased $32.6 million over the 1983 level.

Tennessee's metal industry faced a different market year. Although the demand for domestic steel improved over the period of the early 1980's, a benefit to the State's three steel companies, demand was below plant capacities. Depressed aluminum, copper, and zinc prices had a negative effect on Tennessee producers of these three metal commodities.

**Table 1.—Nonfuel mineral production in Tennessee[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays ... thousand short tons | 1,066 | $26,516 | 1,267 | $30,207 |
| Gem stones | NA | 5 | NA | 5 |
| Phosphate rock ... thousand metric tons | 1,193 | [r]29,073 | 1,368 | 33,275 |
| Sand and gravel: |  |  |  |  |
| Construction ... thousand short tons | [e]6,100 | [e]18,700 | 6,304 | 19,830 |
| Industrial ... do | 483 | 5,455 | 650 | 6,903 |
| Stone: |  |  |  |  |
| Crushed ... do | 30,578 | [r]111,573 | [e]36,200 | [e]138,000 |
| Dimension ... do | 7 | 1,161 | [e]7 | [e]1,097 |
| Zinc (recoverable content of ores, etc.) ... metric tons | 109,958 | 100,336 | 116,526 | 124,854 |
| Combined value of barite, cement, copper, lead (1984), lime, pyrites, and silver | XX | 114,498 | XX | 124,150 |
| Total | XX | [r]407,312 | XX | 478,321 |

[e]Estimated. [r]Revised. NA Not available. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Tennessee, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Anderson | W | W | Stone (crushed), clays. |
| Bedford | (2) | W | Stone (crushed). |
| Benton | W | W | Stone (crushed), sand and gravel (industrial). |
| Bledsoe | -- | W | Stone (crushed). |
| Blount | (2) | W | Stone (crushed), stone (dimension). |
| Bradley | (2) | W | Stone (crused). |
| Campbell | W | W | Stone (crushed), sand and gravel (industrial). |
| Cannon | (2) | W | Stone (crushed). |
| Carroll | W | W | Sand and gravel (industrial), clays. |
| Carter | (2) | W | Stone (crushed). |
| Claiborne | (2) | W | Do. |
| Clay | (2) | W | Do. |
| Cocke | (2) | $143 | Do. |
| Coffee | W | W | Do. |
| Cumberland | W | W | Stone (crushed), stone (dimension). |
| Davidson | (2) | 11,800 | Stone (crushed). |
| Decatur | $1,067 | W | Do. |
| DeKalb | (2) | W | Do. |
| Dickson | (2) | W | Do. |
| Fayette | 62 | (2) | |
| Fentress | (2) | W | Stone (crushed), stone (dimension). |
| Franklin | (2) | W | Stone (crushed). |
| Gibson | W | W | Clays. |
| Giles | W | W | Phosphate rock, stone (crushed). |
| Grainger | (2) | W | Stone (crushed), stone (dimension). |
| Greene | W | W | Do. |
| Hamblen | (2) | W | Do. |
| Hamilton | 19,432 | W | Cement, stone (crushed), sand and gravel (industrial), clays. |
| Hardeman | W | (2) | |
| Hardin | W | W | Stone (crushed). |
| Hawkins | (2) | W | Do. |
| Henry | 7,839 | 9,267 | Clays. |
| Hickman | W | W | Phosphate rock. |
| Humphreys | 525 | -- | Stone (crushed). |
| Jackson | (2) | W | Do. |
| Jefferson | 57,608 | 45,315 | Zinc, stone (crushed). |
| Johnson | (2) | W | Stone (crushed). |
| Knox | 27,367 | 42,388 | Zinc, cement, stone (crushed), stone (dimension), clays. |
| Lauderdale | W | (2) | |
| Lawrence | 12 | (2) | |
| Lincoln | (2) | W | Stone (crushed). |
| Loudon | W | W | Barite, stone (crushed). |
| McMinn | W | W | Lime, stone (crushed). |
| McNairy | W | (2) | |
| Macon | (2) | W | Stone (crushed). |
| Madison | 133 | (2) | |
| Marion | W | W | Cement, stone (crushed). |
| Marshall | (2) | W | Stone (crushed). |
| Maury | W | W | Phosphate rock, stone (crushed). |
| Meigs | (2) | W | Stone (crushed). |
| Monroe | (2) | W | Do. |
| Montgomery | (2) | W | Do. |
| Moore | (2) | W | Do. |
| Morgan | (2) | -- | Do. |
| Obion | 485 | (2) | |
| Overton | 798 | W | Stone (crushed). |
| Pickett | (2) | -- | |
| Polk | 57,079 | W | Pyrites, copper, zinc, silver. |
| Putnam | (2) | W | Stone (crushed). |
| Rhea | (2) | W | Do. |
| Roane | W | W | Do. |
| Robertson | (2) | W | Do. |
| Rutherford | (2) | 3,646 | Do. |
| Sequatchie | (2) | W | Do. |
| Sevier | W | W | Do. |
| Shelby | 3,430 | (2) | |
| Smith | W | W | Zinc, stone (crushed). |
| Stewart | W | W | Stone (crushed). |
| Sullivan | W | W | Cement, stone (crushed), clays. |
| Sumner | (2) | W | Stone (crushed). |
| Tipton | W | (2) | Do. |
| Unicoi | (2) | W | Do. |
| Union | W | W | Lime, stone (crushed). |
| Van Buren | (2) | W | Stone (crushed). |
| Warren | (2) | W | Do. |
| Washington | W | W | Stone (crushed), clays. |
| Wayne | W | (2) | |
| Weakley | 10,917 | 15,026 | Clays. |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Tennessee, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| White | (2) | W | Stone (crushed). |
| Williamson | W | $11,053 | Phosphate rock, stone (crushed). |
| Wilson | (2) | 732 | Stone (crushed). |
| Undistributed[4] | $190,725 | 249,243 | |
| Sand and gravel (construction) | XX | [e]18,700 | |
| Stone: | | | |
| Crushed | W | XX | |
| Dimension | [r] [e]1,238 | XX | |
| Total[5] | [r]378,713 | 407,312 | |

[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Stone, either crushed or dimension, was produced; data not available by county. Total State value is shown separately under "Stone."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Includes gem stones and sand and gravel (industrial) that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Tennessee business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 4,656 | 4,676 | 4,717 |
| Total civilian labor force | do | 2,134 | 2,181 | 2,223 |
| Unemployment | do | 253 | 250 | 190 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 9.2 | 7.9 | 7.9 |
| Metal mining[2] | do | 1.3 | 1.0 | NA |
| Nonmetallic minerals except fuels[2] | do | 2.7 | 2.9 | NA |
| Coal mining[2] | do | 3.8 | 2.9 | NA |
| Oil and gas extraction[2] | do | 1.0 | .8 | NA |
| Manufacturing total | do | 469.5 | 472.4 | 497.6 |
| Primary metal industries | do | 16.4 | 15.4 | 16.6 |
| Stone, clay, and glass products | do | 12.4 | 12.9 | 14.5 |
| Chemicals and allied products | do | 56.3 | 53.8 | 41.6 |
| Petroleum and coal products | do | .7 | .8 | .8 |
| Construction | do | 72.2 | 69.6 | 76.3 |
| Transportation and public utilities | do | 84.0 | 83.6 | 88.5 |
| Wholesale and retail trade | do | 380.5 | 389.9 | 414.7 |
| Finance, insurance, real estate | do | 79.9 | 81.9 | 85.8 |
| Services | do | 313.1 | 323.4 | 345.2 |
| Government and government enterprises | do | 297.5 | 294.1 | 293.0 |
| Tetal | do | [3]1,705.8 | 1,722.8 | 1,809.0 |
| ersonal income: | | | | |
| Total | millions | $41,929 | $44,475 | $49,142 |
| Per capita | | $9,006 | $9,511 | $10,419 |
| ours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.6 | 40.5 | 40.9 |
| Total average hourly earnings, production workers | | $7.16 | $7.49 | $7.93 |
| arnings by industry: | | | | |
| Farm income | millions | $562 | $286 | $699 |
| Nonfarm | do | $30,263 | $32,682 | $36,120 |
| Mining total | do | $226 | $192 | $204 |
| Metal mining | do | $32 | $28 | $30 |
| Nonmetallic minerals except fuels | do | $50 | $58 | $64 |
| Coal mining | do | $113 | $86 | $93 |
| Oil and gas extraction | do | $32 | $20 | $16 |
| Manufacturing total | do | $8,842 | $9,583 | $10,566 |
| Primary metal industries | do | $420 | $425 | $465 |
| Stone, clay, and glass products | do | $276 | $310 | $377 |
| Chemicals and allied products | do | $1,601 | $1,650 | $1,309 |
| Petroleum and coal products | do | $22 | $29 | $29 |
| Construction | do | $1,517 | $1,575 | $1,845 |
| Transportation and public utilities | do | $2,223 | $2,405 | $2,622 |
| Wholesale and retail trade | do | $5,208 | $5,573 | $6,179 |
| Finance, insurance, real estate | do | $1,500 | $1,715 | $1,911 |
| Services | do | $5,487 | $6,126 | $6,989 |
| Government and government enterprises | do | $5,172 | $5,420 | $5,704 |

See footnotes at end of table.

Table 3.—Indicators of Tennessee business activity —Continued

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 15,008 | 29,960 | 37,071 |
| Value of nonresidential construction millions | $792.3 | $900.7 | $826.4 |
| Value of State road contract awards do | $229.5 | $254.0 | $415.0 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,154 | 1,334 | 1,518 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $378.7 | $407.3 | $478.3 |
| Value per capita | $81 | $87 | $101 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; total may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

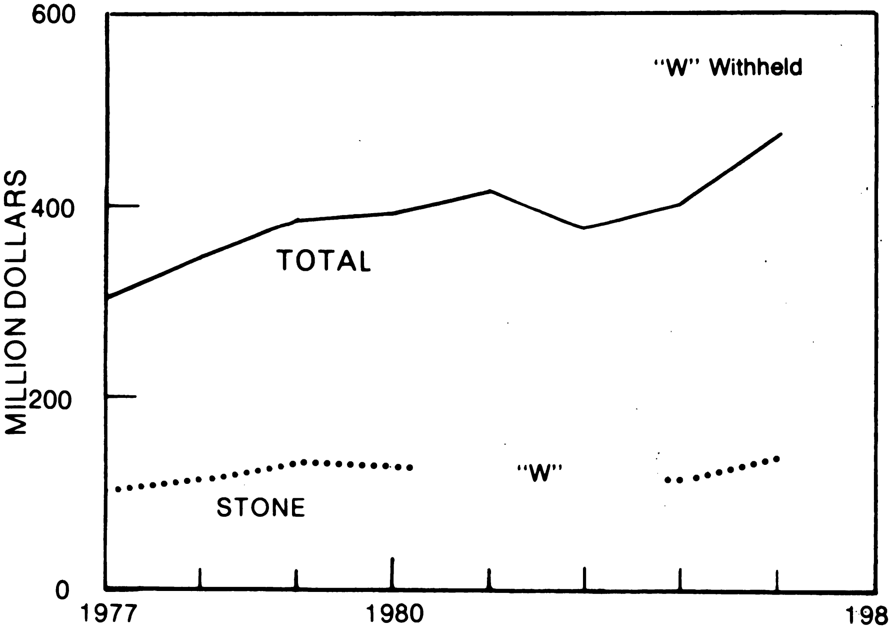

Figure 1.—Value of stone and total value of nonfuel mineral production in Tennessee.

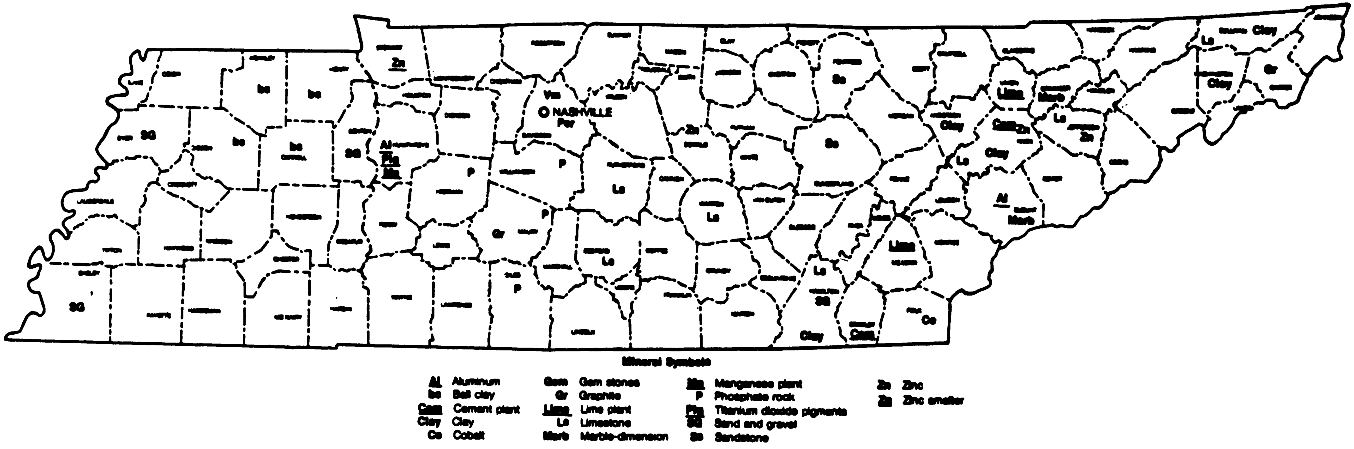

Figure 2.—Principal mineral producing localities in Tennessee.

**Trends and Developments.**—Much of the State's mineral output is used as raw material by the manufacturing sector, and manufacturing employment growth in the State outpaced the Nation's in the first quarter but slowed in the second and third. Boosted by the first quarter strength of residential construction, Tennessee industries associated with building materials posted above-average job gains. Through November, employment in stone, clay, and glass manufacturing was up 11% over the same period in 1983. However, a slowdown in housing starts during the second and third quarters slowed growth in the construction raw materials industries, as well as the lumber and wood industries.

Other industries also were unable to maintain growth through the fourth quarter. Employment and output in the primary and fabricated metals industry fell below the same period in 1983. The drop was largely due to oversupply and imports.[3]

The overall growth in the economy and demand for mineral raw materials spurred construction and expansion plans for several of the State's producers and manufacturers using mineral commodities as a basic raw material. Several expansions or new projects are listed in the following table:

| Company | Location | Activity |
|---|---|---|
| AFG Industries Inc | Greenland | Completed a 600-ton-per-day flat glass furnace. |
| Do | Kingsport | Announced plans to build an amorphous silicon photovoltaic cell facility. |
| Foote Mineral Co | New Johnsonville | Announced plans to construct a 10,200-ton-per-year electrolytic manganese dioxide plant. |
| Knoxville Iron Co | Knoxville | Began a $15 million modernization program. |
| H. C. Spinks Clay Co. Inc | Gleason | Completed two ball clay storage silos. |

Ownership of a number of the State's mineral producers changed during 1984. Several firms with new owners are listed in the following table:

| Company | Commodity | Location | Facility | New owner |
|---|---|---|---|---|
| Chemrock Corp | Expanded perlite | Central Tennessee | Plant | Grefco Inc. |
| Gulf + Western Industries Inc | Zinc | East Tennessee | Mines | Inspiration Mines Co. |
| Ideal Basic Industries Inc | Cement | East Tennessee | Plant | Moore McCormack Cement Inc. |
| Jersey Minière Zinc Co | Zinc | Central Tennessee | Mines and smelter. | Union Zinc Inc. |
| Kentucky-Tennessee Clay Co | Ball clay | Northwest Tennessee. | Mines | Ranchers Exploration and Development Corp. |

River transportation played a significant role in mineral shipments. Cargos shipped into the State during 1984 included steel from Japan; steel coils from Japan, the Republic of Korea, and the Federal Republic of Germany; fertilizer from Israel and Canada; gypsum from Canada and South America; asphalt from Missouri; and salt from Louisiana. Outgoing cargo included zinc bound for Corpus Christi, TX, and coal to Minnesota.[4]

In June, the Tennessee Valley Authority (TVA) opened a $140 million, 1,000-foot navigation lock at Pickwick Landing Dam. Completion of the lock increased the reliability of the barge handling facilities; the lock was second to the Kentucky Dam in the tonnage of lock traffic.

In April, the first producing oil well in western Tennessee was completed. The well, drilled in the Chesterfield Community near Lexington, produced 39% to 40% high-gravity oil from a depth of 1,176 feet.[5]

Nonfuel utilization of coal was initiated by Tennessee Eastman Co. at a plant in Kingsport. The coal was gasified and the gas used to produce acetic anhydride for the manufacture of photographic film, plastics, fibers, and chemicals used in a variety of products ranging from cigarette filters to aspirin substitutes. The facility uses approximately 125,000 tons of high-sulfur coal purchased from a Virginia company. Sulfur was extracted from hydrogen sulfide generated in the coal gasification step.

**Legislation and Government Programs.**—Although no legislation was passed on the State level directly affecting mineral production, several counties enacted legislation that affected local aggregate producers. Campbell, Lawrence, Monroe, and Putnam Counties passed a $0.15-per-ton mineral severance tax on sand, limestone, sandstone, and chert. A similar tax bill was considered by Sevier County Commissioners but was not passed.

During 1984, the Tennessee Division of Geology (TDG), Department of Conservation, had several ongoing projects that dealt with Tennessee's mineral resources. These included the publication of four quadrangle maps containing geology and mineral resource summaries; five additional projects were under way at yearend. The TDG was working with the Department of Health and Environment and the Tennessee Wildlife Resources Agency to prevent and abate water pollution problems resulting from oil and gas well drilling. The TDG continued to maintain and update the computerized oil and gas well data file, which contains information on approximately 8,000 wells. The TDG was working with the U.S. Geological Survey Water Resources Division by providing mineral resource information for several quadrangle maps in the Memphis area.

The Bureau of Mines, the principal minerals engineering agency in the U.S. Department of the Interior, conducted several programs relating to Tennessee's mineral industry. During 1984, all mineral producers in the State were canvassed to develop baseline data on mineral production and value. This was part of an annual, nationwide program to track domestic mineral production and determine demand, trends, and potential areas of shortage prior to their occurrence.

The U.S. Bureau of Mines and Vanderbilt University sponsored a conference on critical and strategic metals in ball bearings. One conference objective was the development of a contingency plan for U.S. technology in the event of disruption of the supply of imported bearing materials.

During the year, the U.S. Bureau of Mines funded two studies, one by the U.S. Department of Energy at Oak Ridge and one by the University of Tennessee at Chattanooga. The former was the "Development of Mineral Resources Assessment Methodologies for U.S. in Nonfuel Mineral Policy Analysis," and the latter was "The Evaluation of Coal Reserves in the Whitewell Shale in the Southern Cumberland Plateau in Tennessee."

In April, the U.S. Office of Surface Mining took control of the inspection of surface coal mines in the State. The Federal agency maintained that the State's enforcement was "grossly inadequate" with only 15% of required on-site inspections performed.[6]

During the year, the TVA was involved with several projects in the energy generation and pollution control areas, which, if proved feasible and adopted, could result in additional mineral sales or energy savings for the minerals industry.

Among these was the development of atmospheric fluidized bed combustion (AFBC). With AFBC, coal is burned in a bed of limestone, providing efficient power production and pollution control. By yearend, a 20-megawatt TVA pilot plant at Paducah, KY, had operated more than 8,500 hours using the process.

Another project involved the nonconvecting, salt-gradient solar pond (NCSP). Work was ongoing to determine the technical and economic feasibility of NCSP technology for supplying low-temperature process heat for industrial and commercial applications.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

Industrial minerals output accounted for 72% of the value of mineral sales during 1984. This was a 1% decrease from that reported for 1983. The three leading industrial minerals produced, in terms of value, were crushed stone, phosphate rock, and clays, accounting for 42% of the State's total value.

**Barite.**—A. J. Smith Co. produced barite, a barium sulfate, by open pit mining in Loudon County. After washing, barite concentrates were shipped out of State for processing. Much of the Tennessee barite was used in the manufacture of chemicals and paint.

**Cement.**—The State's cement industry consists of two companies with plants in eastern Tennessee. Portland and masonry cement were produced by both companies.

Dixie Cement Co. Inc. is a subsidiary of Moore McCormack Cement Inc. and Signal Mountain Cement Co. is owned by IFI International. Production and value of portland cement increased approximately 7% and 19%, respectively. Masonry cement output decreased 4% and value increased 5%.

### Table 4.—Tennessee: Cement industry, 1984

| Company | Location | Process | Number of kilns | Annual clinker capacity (thousand short tons) |
|---|---|---|---|---|
| Dixie Cement Co. Inc | Knoxville | Wet | 2 | 550 |
| Signal Mountain Cement Co | Chattanooga | Wet | 2 | 450 |

**Clays.**—The Tennessee clay industry consisted of 9 companies operating 32 mines in 5 eastern and 4 western counties. These companies produced common clay and shale, ball clay, and fuller's earth.

H. C. Spinks Clay Co. Inc., a ball clay producer, completed the construction of two 100-ton silos for storing air-float clays at the company's drying and grinding plant at Gleason. One silo is reserved for railcar loading and the second is for trailers.

In July, National Gypsum Co. announced plans to expand its American Olean Tile Div. with the construction of a $20 million ceramic mosaic tile plant in Jackson. The facility, the company's second in the United States, will begin operation in 1985 and is designed to produce more than 10 million square feet of unglazed and glazed tile annually.

### Table 5.—Tennessee: Clays sold or used by producers

| Year and type | Quantity (short tons) | Value | |
|---|---|---|---|
| | | Total | Average per ton |
| 1983: | | | |
| Ball clay | 507,744 | $16,955,610 | $33.39 |
| Common clay and shale[1] | 433,221 | 955,685 | 2.20 |
| Total | 940,965 | 17,911,295 | XX |
| 1984: | | | |
| Ball clay | 606,870 | 21,249,030 | 35.01 |
| Common clay and shale[1] | 560,278 | 1,165,263 | 2.08 |
| Total | 1,167,148 | 22,414,293 | XX |

XX Not applicable.

[1] Used in manufacturing building bricks and portland cement.

### Table 6.—Tennessee: Ball clay sold or used by producers, by kind and use

(Short tons)

| Use | 1983 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Air-float | Unprocessed | Total | Air-float | Unprocessed | Total |
| Electrical porcelain | 12,349 | -- | 12,349 | 18,356 | -- | 18,356 |
| Fine china and dinnerware | W | -- | W | 28,020 | -- | 28,020 |
| Floor and wall tile, ceramic | 36,460 | W | 36,460 | 59,134 | W | 59,134 |
| Pottery | 117,244 | W | 117,244 | 118,680 | W | 118,680 |
| Sanitary ware | W | W | 123,743 | 36,350 | W | 36,350 |
| Other[1] | 112,306 | 168,570 | [2]157,133 | 82,687 | 199,142 | 281,829 |
| Exports | 37,578 | 23,237 | 60,815 | 63,060 | 1,441 | 64,501 |
| Total | 315,937 | 191,807 | 507,744 | 406,287 | 200,583 | 606,870 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes data used in animal feed; common bricks; catalysts (oil refining); crockery and earthenware; firebrick, block and shapes; high-alumina refractories; kiln furniture; mortar and cement; pesticides and related products; roofing granules; rubber; unknown uses; and data indicated by symbol W.

[2] Incomplete total; remainder included with individual uses.

**Graphite (Synthetic).**—Union Carbide Corp. and Great Lakes Carbon Corp. produced graphite products at three plants. Petroleum coke and coal tar pitch provided the raw material for the three facilities. Union Carbide operated plants at Clarksville in Montgomery County and near Columbia in Maury County. Output from both facilities was principally for the manufacture of electrodes used in electric arc steel making furnaces. In 1984, electric arc furnaces accounted for approximately one-third of the raw steel production in the United States.[7]

Great Lakes Carbon operated a plant in Elizabethton in Carter County to produce high modulus graphite fibers. These fibers were used in the aerospace, sports equipment, and automotive industries.

**Lime.**—Tenn-Luttrell Lime Co. and Bowater Southern Paper Corp. were the State's two lime producers. Tenn-Luttrell, with a plant at Luttrell near Knoxville, mined a local limestone as a raw material while Bowater preduced lime as a byproduct of paper manufacture. Principal markets included the paper and steel industries; lime was also sold for water purification applications.

**Lithium.**—Foote Mineral Co. operated a plant at New Johnsonville to produce organo-lithium compounds. The plant, constructed in 1962, uses lithium carbonate, obtained from company operations at Kings Mountain, NC, and Silver Peak, NV, and lithium metal to produce a material used in lubricants, pharmaceuticals, and for rubber manufacture.

**Phosphate Rock.**—The State ranked fourth behind Florida, North Carolina, and Idaho in phosphate rock output. Three companies, Monsanto Co. and Occidental Chemical Corp. in Columbia and Stauffer Chemical Co. at Mount Pleasant, produced elemental phosphorus from phosphate rock mined under contract. The phosphate rock, occurring in residual clays weathered from phosphate-rich Ordovician limestones, was recovered by surface methods from sites in Giles, Hickman, Maury, and Williamson Counties. The phosphate rock was converted into elemental phosphorus, which was manufactured into a variety of individual chemicals.

**Pyrites.**—The Ducktown Basin in Polk County in southeastern Tennessee has been the scene of pyrite production for the past 180 years. In 1984, Tennessee Chemical Co. operated a mining beneficiation and chemical manufacturing complex at Copper Hill.

Sulfide ore, pyrrhotite (60%), chalcopyrite (30%), sphalerite (4%), magnetite (2%), and traces of silver and gold were produced from surface and underground mines.

Primary crushers located underground prepared the ore for transport to the London mill where, after further crushing and grinding, a sulfide concentrate was recovered by flotation. Iron minerals were removed by magnetic separation. Copper and iron concentrates, recovered from the flotation process, were transported to the company's copper smelter and four iron roasters.

Principal products included sulfuric acid and liquid sulfur dioxide. Byproducts included blister copper, zinc concentrates, and magnetite. The Copper Hill chemical complex produced a variety of organic and inorganic chemicals. In April, company officials announced that the depressed copper and sulfur markets could force the company's closing. The company employs 1,300 workers, 500 from Polk County, and supplies about 95% of the county's tax base.

**Refractories.**—C-E Minerals Inc. operated a fused silica and fused magnesium oxide plant in Greeneville. Fused silica sales are for silica nozzles and shrouds in continuous casting, and the material is also used in the manufacture of coke oven door liners, glass tank block, crucibles, special shapes, and foam block. Fused magnesium oxide has applications in basic brick and ramming mixes and as plastics for steel melting furnaces.

**Sand and Gravel.**—Tennessee's sand and gravel industry, 49 companies and government agencies operating 63 mines, produced 6.95 million short tons valued at $26.7 million in 1984. This was an increase of about 371,000 tons and about $2.6 million over that reported in 1983.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend. The State's construction sand and gravel industry consisted of 43 companies or government agencies operating 57 mines in a 27-county area. Production was in 3 principal areas, which accounted for over 80% of the value: 13 of the 21 counties west of the Tennessee River (60%); Hamilton and Marion Counties in the southeastern part of the State; and in northeastern Tennessee (Cumberland, Fentress, Overton, and Putnam Counties).

Table 7.—Tennessee: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 1,143 | $3,616 | $3.17 |
| Plaster and gunite sands | 185 | 763 | 4.13 |
| Concrete products | 209 | 719 | 3.44 |
| Asphaltic concrete | 1,024 | 5,307 | 5.18 |
| Road base and coverings | 1,548 | 3,278 | 2.12 |
| Fill | 24 | 51 | 2.12 |
| Other[1] | 2,172 | 6,096 | 2.81 |
| Tetal or average | [2]6,304 | 19,830 | 3.15 |

[1] Includes roofing granules and other unspecified uses.

[2] Data do not add to total shown because of independent rounding.

*Industrial.*—Industrial sand and gravel production in Tennessee increased 167,000 short tons between 1983 and 1984. In 1984, the industry was in a four-county area in the western part of the State and in two counties in the Cumberland Plateau area of eastern Tennessee. The majority of production, 81%, was from the Benton, Carroll, and Henry Counties contiguous area in northwestern Tennessee. Hardeman was the fourth western Tennessee county with industrial sand production. Output from the industrial sand industry in these four counties was sold, in descending order, for container, molding, golf course, and traction sand applications.

Industrial sand and gravel, produced in Campbell and Hamilton Counties in the Cumberland Plateau area, was marketed for roofing, filtration, and coal washing applications.

Container sand had the highest unit value, followed by molding, coal washing, traction, roofing, and golf course sands. The average unit value for all uses was $10.62 per short ton.

The increase in production between 1983 and 1984 was primarily in the tonnages of container sand, 30%; roofing sand and gravel, 50%; molding sand, 81%; and for filtration applications, 158%.

**Slag, Iron and Steel.**—Slag from the State's two steel producers was sold for general aggregate purposes.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numberod years are based on annual company estimates made before yearend.

*Crushed.*—In 1983, the last year that detailed data were canvassed, Tennessee's stone industry consisted of 115 limestone-dolomite producers, 1 granite operation, and 1 marble operation.

During the year, four counties passed a $0.15-per-ton severance tax, which included limestone, dolomite, and chert.

*Dimension.*—Several companies quarried sandstone from the Cumberland Plateau area for material used in a variety of construction applications.

The John J. Craig Co. quarried marble from a quarry near Friendsville. The stone was gang-sawed prior to its sale to finishing plants.

During the year, Armstar began operation of a cast stone plant at Lenoir City. Marble chips and powdered resin are mixed, placed in a mold, and subjected to pressure. After curing at 180° F, the synthetic stone is sawed and polished similar to natural dimension stone.

**Vermiculite (Exfoliated).**—W. R. Grace & Co.'s Construction Products Div. exfoliated vermiculite, primarily for the insulation market, at a plant in Nashville. Crude vermiculite was shipped from company mines in South Carolina.

## METALS

Tennessee's metal producers viewed 1984 in a different light than did the industri minerals sector of the industry. Althoug the demand for domestic steel remain relatively steady, which helped sales by th State's two steel producers, a worldwic glut of aluminum forced prices below pr duction costs and the two instate aluminu smelters closed potlines by midyear to ac just output and inventories. Domestic co per prices remained depressed owing t foreign imports, which adversely affect production and sales by the State's onl copper producer. Low zinc prices and labc problems had a negative impact on the zin industry.

**Aluminum.**—Tennessee's aluminum in dustry consisted of the Aluminum Co. America (Alcoa) with a 220,000-short-ton per-year smelter complex at Alcoa Blount County, and Consolidated Alum num Corp. with a 146,000-ton-per-yea smelter at New Johnsonville in Humphrey

County. Consolidated also operated an aluminum foil and coated-sheet facility in Jackson.

In midyear, a weakness in the worldwide aluminum market forced both producers to seek supply-side solutions and, as metal prices fell below ingot production costs, both companies announced production cutbacks.

In late June, Alcoa announced plans to terminate preduction from one-half of a potline, decreasing output from the Alcoa complex by 50,000 metric tons. In July, Consolidated shut the third of the New Johnsonville smelter's four potlines, leaving only one in operation. A continued deterioration in the price for primary aluminum and high TVA power rates were cited as reasons for the shutdown.

In October, Consolidated closed one-half of the remaining potline, cutting production to approximately 18,250 short tons per year. A weak aluminum market and power rates were again cited for the curtailment.

In October, Consolidated and the Aluminum, Brick and Glass Workers International Union signed a contract ending a 3-month strike at the Jackson foil and coated-sheet mill. Under the new contract, the union made concessions on wages, job duties, and work practices to reduce production costs; the company agreed to retain the "successor clause," which states that should the company decide to sell the Jackson facility, the contract with the union would remain in force.

In November 1983, Alcoa announced plans to invest $250 million to modernize the Alcoa facility. In November 1984, work began to upgrade the 1942-vintage North plant into a world-class sheet mill facility. Upon completion, the Alcoa facility will be equipped to roll wide, high-quality sheet for the container and building markets.

A continuous feed, multistand, cold-rolling mill is the heart of the expansion project. The modernization program will also upgrade an existing mill at the Alcoa complex, adding the capability to handle 80-inch sheet. The project is scheduled to be completed in 3 years.

**Copper.**—Tennessee Chemical produced blister copper from concentrates recovered during the beneficiation of sulfide ore mined in the Ducktown area of southern Tennessee. The company operates two underground mines and one surface mine, an ore beneficiation plant, and a metallurgical chemical complex at Copperhill, Polk County.

Concentrates, recovered by flotation during sulfide mineral beneficiation, are shipped by rail to a company smelter for blister copper production. Copper and copper compounds, blister copper, copper sulfate, and copper carbonate account for approximately 30% of the company's sales.

**Table 8.—Tennessee: Mine production (recoverable) of gold, silver, copper, and zinc**

| | 1982 | 1983 | 1984 |
|---|---|---|---|
| Mines producing: Lode | 10 | 9 | 8 |
| Ore sold or treated: | | | |
| Copper-zinc thousand metric tons | 1,604 | 1,822 | W |
| Zinc do | 4,446 | 4,019 | W |
| Total do | 6,050 | [1]5,842 | 6,071 |
| Production: | | | |
| Quantity: | | | |
| Copper metric tons | W | W | W |
| Lead do | -- | -- | W |
| Silver troy ounces | W | W | W |
| Zinc metric tons | 121,306 | 109,958 | 116,526 |
| Value: | | | |
| Copper thousands | W | W | W |
| Lead do | -- | -- | W |
| Silver do | W | W | W |
| Zinc do | $102,882 | $100,336 | $124,854 |

W Withheld to avoid disclosing company proprietary data.
[1] Data do not add to total shown because of independent rounding.

Depressed copper prices and foreign imports of copper were said to be the cause of severely restricted sales. Although Tennessee Chemical's major product is sulfuric acid, the depressed copper market has forced company officials to seriously consider the termination of mining operations. The company could purchase raw materials necessary to the production of sulfuric acid cheaper than the material can be mined and beneficiated at the southeastern Tennessee complex.[8]

In July, company employees, along with those of 11 other major U.S. copper companies, filed a protest with the International Trade Commission (ITC), claiming that imported copper had created a depressed market for U.S. copper production. Although the ITC voted five to zero in favor of the U.S. copper companies and recommended that either a quota or tariff be placed on imported copper, no action was taken.

**Ferroalloys.**—Tennessee ranked third in the Nation in ferroalloy shipments.

Table 9.—Tennessee: Ferroalloy producers, 1984

| Company | Plant location | Alloy |
|---|---|---|
| International Minerals & Chemical Corp | Kimball | Ferrosilicon and specialty silicon alloys. |
| Monsanto Co | Columbia | Ferrophosphorus. |
| Occidental Petroleum Corp | do | Do. |
| Stauffer Chemical Co | Mount Pleasant | Do. |

The Chromium Mining & Smelting Corp., unsuccessful in locating a buyer for its Woodstock plant, permanently closed the facility in September. The plant was equipped with four high-carbon ferrochromium furnaces and one low-carbon ferrochromium furnace. Total plant capacity was approximately 98,000 short tons per year.

**Germanium.**—Jersey Minière Zinc Co. produced germanium as a byproduct from zinc ore mined at the company's Elmwood and Gordonsville operations. Germanium residues, recovered at the Clarksville smelter, were shipped to the Belgium firm, Métallurgie Hoboken-Overpelt SA, for recovery of germanium.

In 1984, a germanium oversupply caused by production from new operations and a slight decrease in demand in the electronics industry affected sales.

**Iron and Steel.**—The Tennessee iron and steel industry is composed of two companies with a rated annual capacity of 460,000 short tons.

Knoxville Iron Co., a subsidiary of Goldfields American Industries Inc., announced plans for a $15 million expansion, which will include the addition of a 50-ton electric furnace and a continuous caster. One 35-ton furnace will be eliminated. Completion is scheduled for 1986.

**Lead.**—General Smelting & Refinery Co., College Grove, a secondary lead smelter, refined plates from scrap automobile batteries. In May, General Smelting was requested to supply the State plans for monitoring ground water around two acid-holding ponds or close the impoundments. In June, the facility was partially destroyed by fire and a series of explosions.

**Manganese.**—In midyear, Foote announced plans to construct a $17.4 million, 10,200-short-ton-per-year electrolytic manganese dioxide plant to replace the existing manganese metal plant at New Johnsonville, which was closed in June 1983.

The new manganese dioxide facility is scheduled for one of two cell rooms originally designed to produce manganese metal. One cell room would be maintained so that manganese metal production could resume if market conditions so warrant. The manganese dioxide facility is scheduled for completion in late 1985.

Tennessee Eastman in Kingsport, a division of Eastman Kodak Co., announced that in 1986 it will discontinue a process requiring manganese ore. The process, which produces a photographic developer, also produces manganese sulfate as a byproduct, and the process change will reduce domestic manganese sulfate supply. Manganese sulfate is an intermediate material in the production of other manganese chemicals and manganese dioxide. It is also used in fertilizer and animal feed.

**Platinum.**—National Refining Corp. operated a modern precious metals scrap refinery in Gallatin. The company's platinum-group metals division specialized in precious metals recovery services for the chemical, petrochemical, petroleum, and pharmaceutical industries. In 1984, the group was working with industries using platinum, palladium, and rhodium metals on carbon and alumina supports. The company's total precious metals recovery and recycling system served a variety of industries including medical, photographic, electrical, and X-ray film manufacturers.

**Rare Earths and Thorium.**—W. R. Grace operated a rare-earth and thorium plant, Davison Specialty Chemicals Co., in Chattanooga. Monazite is imported from Australia and Malaysia through the port of Charleston, SC, then by rail to Chattanooga.

The monazite is ground and reacted with hot caustic soda to yield a mixture of rare earths and thorium hydroxide. Hydrochloric acid is then reacted with the thorium hydroxide to yield a rare-earth solution. Several other chemicals are used to produce rare-earth products from the chloride solution. Cerium and rare-earth oxides are calcined in a rotary kiln. The principal product is a rare-earth chloride used in the manufacture of fluid cracking catalysts.

Other products from the facility and their uses are as follows:

| Product | Uses |
|---|---|
| Rare-earth fluorides and oxides. | Carbon arc industry and metallurical alloys. |
| Rare-earth chloride | Textile paint industries. |
| Cerium compounds | Specialty glass. |
| Cerium oxides | Glass and plastic lens polishing media. |

**Zinc.**—Tennessee has led the Nation in zinc production for several decades and this was true again in 1984. The State's zinc industry consisted of four companies operating eight underground zinc mines in the eastern and central part of the State and one company recovering zinc concentrate as a byproduct of sulfide ore beneficiation, and accounted for approximately 46% of the U.S. recoverable zinc production.

In February, the U.S. Bureau of the Mint awarded The New Jersey Zinc Co. Inc., the sales agent for Jersey Minière, a contract for $2,840,700 for 5.5 million pounds of zinc. The metal will be shipped to the Ball Corp. in Greenville for penny blank fabrication.[9]

In May, Gulf + Western Industries Inc. sold its 60% interest in Jersey Minière to Union Zinc Inc., a subsidiary of Union Minière SA of Belgium.[10] The transaction made Jersey Minière the first domestic zinc producer wholly owned by a foreign firm. Union Miniére owned 40% of the company before the sale. In addition to the mines mentioned in table 11, Jersey Minière also owned a 90,000-ton-per-year electrolytic zinc refinery in Clarksville.

**Table 10.—Tennessee: Tenor of zinc ore milled and concentrates produced**

| | 1983 | 1984 |
|---|---|---|
| Total material metric tons | 5,841,702 | 6,071,125 |
| Metal content of ore:[1] Zinc percent | 1.88 | 2.02 |
| Concentrates produced and average content: | | |
| Zinc concentrate metric tons | 177,747 | 193,970 |
| Average zinc content percent | 63.74 | 63.27 |

[1]Figures represent metal content of crude ore only as contained in the concentrate.

**Table 11.—Tennessee: Zinc industry, 1984**

| Company | Mine | Mill |
|---|---|---|
| ASARCO Incorporated | Coy | Mascot. |
| Do | Immel | Do. |
| Do | New Market | New Market. |
| Do | Young | Mascot. |
| Inspiration Resources Corp | Beaver Creek | Jefferson City. |
| Jersey Minière Zinc Co. | Elmwood and Gordonsville | Elmwood. |
| United States Steel Corp | Jefferson City | Jefferson City. |

Following the sale, Union Zinc and Afrimet Indussa Inc. reached an agreement whereby Afrimet became the sole sales agent for Union Zinc.[11]

Reportedly, Union Minière plans to extend its mining operations to develop the Stonewall ore body at Stonewall adjacent to the Elmwood and Gordonsville ore bodies. The development of Stonewall would increase the feed of high-grade, low-iron zinc to the Clarksville refinery. The addition of the Stonewall reserves would reduce the need to purchase outside zinc concentrates.[12]

In June, Jersey Minière reduced zinc output at the Clarksville facility to 75% of capacity in response to "weakening market conditions." Concurrent with the cutback, the company reduced the price for High Grade zinc by 3 cents to 50 cents per pound. Special High Grade was reduced to 50.5 cents per pound, and Prime Western and continuous galvanizing grades were reduced to 50.75 cents per pound.[13]

In August, members of the United Steelworkers of America struck when their 3-year contract expired, closing the Elmwood and Gordonsville Mines. The refinery remained in operation; the mines supply 50% of the concentrate and the remainder was purchased.[14] After 11 weeks, a new contract was approved.[15]

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] Geologist, Tennessee Division of Geology, Knoxville, TN.

[3] Federal Reserve Bank of Atlanta. Economic Review. Feb. 1985, p. 37.

[4] Knoxville News Sentinel. Rolling on the River. Mar. 21, 1984.

[5] Jackson Journal. Oil Boom Begins With Local Strike. Aug. 15, 1984.

[6] Memphis Daily. A Fresh Start. July 20, 1984.

[7] American Metal Market. Electric Arc Furnaces Seen Accounting for 40% of Output. May 2, 1984.

[8] Knoxville Journal. Tennessee Chemical May Close Within Year. Apr. 14, 1984.

[9] American Metal Market. Mint Awards Five Zinc Pacts. Feb. 28, 1984.

[10] ———. Gulfwestern Sells Stake in Jersey Minière. May 10, 1984.

[11] ———. Afrimet Ups Share of U.S. Zinc Market. May 15, 1984.

[12] Metals Week. Union Minière Buys G + W's Stake in Jersey Minière. May 19, 1984.

[13] American Metal Market. Jersey Minière Reducing Zinc Production at Tennessee Smelter to 75% of Capacity. June 29, 1984.

[14] ———. Jersey Minière Refining Not Halted by Strike. Aug. 6, 1984.

[15] Chattanooga News-Free Press. Zinc Workers End Walkout, OK Contract. Oct. 17, 1984.

## Table 12.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum smelters: | | | |
| Aluminum Co. of America | Box 158<br>Alcoa, TN 37701 | Plant | Blount. |
| Consolidated Aluminum Corp | 1102 Richmond St.<br>Jackson, TN 38301 | do | Humphreys. |
| Barite: | | | |
| A. J. Smith Co | Route 3<br>Sweetwater, TN 37874 | Open pit mine | Loudon. |
| Cement: | | | |
| Moore McCormack Cement Inc., a subsidiary of Moore McCormack Resources Inc. | Box 23965<br>Tampa, FL 33622 | Plant | Knox. |
| Signal Mountain Cement Co | 1300 American National Bank Bldg.<br>Chattanooga, TN 37402 | do | Hamilton. |
| Clays: | | | |
| Cyprus Industrial Minerals Co | Box 111<br>Gleason, TN 38229 | Pits and plants | Carroll and Weakley. |
| General Shale Products Corp | Box 3547 CRS<br>Johnson City, TN 37601 | do | Anderson, Hamilton, Knox, Sullivan, Washington. |
| Kentucky-Tennessee Clay Co | Box 449<br>Mayfield, KY 42066 | do | Carroll, Gibson, Henry, Weakle |
| H. C. Spinks Clay Co. Inc | Box 820<br>Paris, TN 38229 | do | Carroll, Henry, Weakley. |
| Copper: | | | |
| Tennessee Chemical Co.[1] | Copperhill, TN 37317 | Underground mines, surface mine, plant. | Polk. |
| Graphite (synthetic): | | | |
| Great Lakes Carbon Corp | Box 1301<br>Elizabethton, TN 37643 | Plant | Carter. |
| Union Carbide Corp | Box 513<br>Columbia, TN 38401 | do | Maury. |
| Lime: | | | |
| Bowater Southern Paper Corp | Calhoun, TN 37309 | do | McMinn. |
| Tenn-Luttrell Lime Co | Box 69<br>Luttrell, TN 37779 | do | Union. |
| Perlite (expanded): | | | |
| Chemrock Corp | Osage St.<br>Nashville, TN 37208 | do | Davidson. |
| Phosphate rock: | | | |
| Monsanto Co.[2] | Columbia, TN 38401 | do | Do. |
| Occidental Chemical Corp.[2] | Box 591<br>Columbia, TN 38401 | do | Do. |
| Stauffer Chemical Co.[2] | Box 89<br>Mount Pleasant, TN 38474 | do | Do. |
| Sand and gravel (1982): | | | |
| Dixie Sand & Gravel Co | 515 River St.<br>Chattanooga, TN 37402 | Pits | Hamilton. |
| Memphis Stone & Gravel Co | Box 1683<br>Memphis, TN 38101 | do | Benton, Dyer, Shelby. |
| Rogers Group Inc.[3] | Box 25250<br>Nashville, TN 37202 | do | Tipton. |
| Standard Construction Co. Inc | Box 38289<br>Germantown, TN 38138 | Pit | Shelby. |

See footnotes at end of table.

## Table 12.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| **Stone:** | | | |
| **Limestone:** | | | |
| American Limestone Co | Box 2389<br>Knoxville, TN 37901 | Quarries | Jefferson, Knox, Sullivan. |
| Koppers Co. Inc. (Stoneman Inc.) | Box 231<br>Easton, PA 18042 | do | Bedford, Hamilton, Rutherford, Warren. |
| Vulcan Materials Co | Box 7<br>Knoxville, TN 37901 | do | Do. |
| **Marble:** | | | |
| John J. Craig Co | Box 9300<br>Knoxville, TN 37920 | Quarry | Blount. |
| Imperial Black Marble Corp | 8013 Chesterfield Dr.<br>Knoxville, TN 37919 | do | Grainger. |
| **Sandstone:** | | | |
| Ross L. Brown Cut Stone Co. Inc. | Box 398<br>Crab Orchard, TN 37723 | do | Cumberland. |
| Crab Orchard Stone Co. Inc | Drawer J<br>Crossville, TN 38555 | do | Do. |
| Crossville Limestone Co. Inc | Box 485<br>Crossville, TN 38555 | do | Do. |
| Mountain Stone Co | Box 246<br>Jamestown, TN 38556 | do | Fentress. |
| **Vermiculite (exfoliated):** | | | |
| W. R. Grace & Co | 4061 Powell Ave.<br>Nashville, TN 37204 | Plant | Davidson. |
| **Zinc:** | | | |
| ASARCO Incorporated[3] | Mascot, TN 37806 | Underground mines and plant. | Jefferson and Knox. |
| Inspiration Resources Corp | Box 32<br>Jefferson City, TN 37760 | Underground mine and plant. | Jefferson. |
| Jersey Minière Zinc Co | Elmwood, TN 38560 | Underground mines, plant, smelter. | Smith. |
| United States Steel Corp.[3] | Jefferson City, TN 37760 | Underground mine | Jefferson. |

[1] Also silver and zinc.
[2] Also ferroalloys.
[3] Also stone.

# The Mineral Industry of Texas

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Economic Geology, The University of Texas at Austin, for collecting information on all nonfuel minerals.**

**By Jane P. Ohl[1] and Mary W. McBride[2]**

Total value of nonfuel minerals produced in Texas in 1984 was $1.71 billion, a 13.7% increase over that of 1983. The State ranked second in the Nation. Texas retained its position as the leading producer of native asphalt, portland cement, gypsum, magnesium chloride, crushed stone, Frasch sulfur, and talc, and ranked second nationwide in production of clays, helium, salt, construction sand and gravel, and natural sodium sulfate.

In 1984, 21 nonfuel minerals were mined in the State, 1 metal and 20 nonmetals. Portland and masonry cement provided 34% of the total value and, with stone and sand and gravel, added to well over 65% of the total.

Per capita value of nonfuel mineral production was $107, compared with $98 nationally.

**Table 1.—Nonfuel mineral production in Texas[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Cement: | | | | |
| Masonry thousand short tons | 276 | $19,704 | 291 | $24,409 |
| Portland do | 9,760 | 534,298 | 10,423 | 557,421 |
| Clays do | 3,955 | 22,575 | 3,594 | 23,051 |
| Gem stones | NA | 225 | NA | 175 |
| Gypsum thousand short tons | 2,049 | 16,357 | 2,166 | 19,431 |
| Helium (Grade-A) million cubic feet | 524 | 18,340 | W | W |
| Lime thousand short tons | 1,067 | 60,193 | 1,157 | 61,214 |
| Salt do | 8,028 | 65,670 | 8,184 | 69,672 |
| Sand and gravel: | | | | |
| Construction do | [e]58,500 | [e]208,000 | 62,389 | 199,461 |
| Industrial do | 1,788 | 29,637 | 2,028 | 29,282 |
| Stone: | | | | |
| Crushed do | [r]76,328 | [r]239,187 | [e]89,200 | [e]300,000 |
| Dimension do | 50 | 11,071 | [e]47 | [e]11,236 |
| Sulfur (Frasch) thousand metric tons | 2,468 | W | 2,994 | W |
| Talc and pyrophyllite thousand short tons | 250 | 3,933 | 283 | 5,703 |
| Combined value of asphalt (native, 1984), fluorspar, helium (crude), iron ore, magnesium chloride, magnesium compounds, mica (scrap, 1984), sodium sulfate, and values indicated by symbol W | XX | [r]279,291 | XX | 414,352 |
| Total | XX | [r]1,508,481 | XX | 1,715,407 |

[e]Estimated. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Texas, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Andrews | -- | W | Stone (crushed). |
| Atascosa | W | W | Sand (industrial). |
| Bandera | (2) | W | Stone (crushed). |
| Bastrop | W | W | Clays. |
| Bee | -- | W | Do. |
| Bell | W | $6,001 | Stone (crushed). |
| Bexar | W | W | Cement, stone (crushed), lime, clays. |
| Borden | W | (3) | |
| Bosque | W | W | Lime, stone (crushed). |
| Bowie | $445 | (3) | |
| Brazoria | 128,544 | W | Magnesium chloride, salt, magnesium compounds. |
| Brazos | W | (3) | |
| Brewster | W | W | Fluorspar. |
| Brown | (2) | W | Stone (crushed). |
| Burleson | (2) | W | Do. |
| Burnet | W | 30,207 | Stone (crushed), stone (dimension), lime. |
| Calhoun | W | W | Lime. |
| Callahan | -- | W | Stone (crushed), stone (dimension, lime. |
| Cass | W | W | Iron ore. |
| Chambers | W | W | Salt. |
| Cherokee | W | W | Iron ore, clays. |
| Coke | W | (3) | |
| Coleman | W | W | Clays. |
| Collin | (2) | W | Stone (crushed). |
| Collingsworth | -- | W | Do. |
| Colorado | 42,725 | W | Sand (industrial). |
| Comal | W | 69,544 | Cement, stone (crushed), lime. |
| Comanche | (2) | W | Clays. |
| Concho | -- | 1,185 | Do. |
| Cooke | W | W | Stone (crushed). |
| Coryell | 350 | W | Do. |
| Crockett | (2) | -- | |
| Crosby | W | (3) | |
| Culberson | W | W | Sulfur, talc, stone (crushed). |
| Dallas | W | W | Cement, stone (crushed), clays. |
| Deaf Smith | W | W | Lime, stone (crushed). |
| Denton | W | W | Clays. |
| Donley | -- | 69 | Do. |
| Duval | W | W | Salt, stone (crushed). |
| Eastland | W | 1,553 | Clays, stone (crushed). |
| Ector | 43,765 | W | Cement, stone, (crushed), salt. |
| Edwards | -- | W | Stone (crushed). |
| Ellis | W | W | Cement, stone (crushed), clays. |
| El Paso | W | W | Cement, stone (crushed), stone (dimension). |
| Fannin | W | (3) | |
| Fayette | W | 1,950 | Clays. |
| Fisher | W | W | Do. |
| Floyd | -- | W | Do. |
| Fort Bend | 25,820 | W | Salt, stone (crushed) clays. |
| Freestone | W | W | Stone (crushed). |
| Gaines | W | W | Sodium sulfate, stone (crushed). |
| Galveston | W | -- | |
| Gillespie | W | 1,722 | Gypsum, stone (dimension), stone (crushed). |
| Gonzales | W | W | Clays. |
| Grayson | (2) | 2,278 | Stone (crushed). |
| Gregg | 166 | (3) | |
| Guadalupe | W | W | Clays. |
| Hale | -- | W | Do. |
| Hall | W | (3) | |
| Hansford | W | W | Stone (crushed). |
| Hardeman | W | W | Gypsum. |
| Hardin | W | 392 | Sand (industrial). |
| Harris | 102,899 | 59,504 | Cement, salt, sand (industrial), clays. |
| Harrison | W | W | Clays. |
| Hays | W | W | Cement, stone (crushed). |
| Henderson | W | W | Clays. |
| Hidalgo | W | 1,088 | Stone (crushed). |
| Hill | W | W | Lime, stone (crushed). |
| Hood | (2) | W | Stone (crushed). |
| Howard | W | (3) | |
| Hudspeth | W | 3,997 | Talc, stone (crushed), gypsum. |
| Hutchinson | 2,492 | (3) | |
| Jack | (2) | W | Stone (crushed). |
| Jasper | (2) | W | Do. |
| Jefferson | W | W | Salt. |
| Jim Wells | (2) | 376 | Stone (crushed). |
| Johnson | W | W | Lime, sand (industrial), stone (crushed). |
| Jones | W | 125 | Stone (dimension). |
| Kaufman | (2) | 2,886 | Stone (crushed). |
| Kerr | W | (3) | Do. |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Texas, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Kimble | W | W | Gypsum. |
| Lamb | (2) | W | Stone (crushed). |
| Lampasas | $82 | W | Do. |
| Liberty | W | W | Sulfur, sand (industrial). |
| Limestone | W | $18,709 | Stone (crushed), sand (industrial), clays. |
| Lipscomb | (2) | -- | |
| Live Oak | W | W | Sand (industrial), stone (crushed). |
| Llano | (2) | W | Stone (dimension). |
| Lubbock | (2) | -- | Stone (crushed). |
| McCulloch | W | 13,702 | Sand (industrial). |
| McLennan | W | W | Cement, stone (crushed), clays. |
| McMullen | (2) | W | Stone (crushed). |
| Marion | W | -- | |
| Martin | -- | W | Do. |
| Mason | (2) | -- | |
| Matagorda | W | W | Salt. |
| Medina | W | 63 | Clays. |
| Midland | (2) | 1,267 | Stone (crushed). |
| Montague | -- | W | Do. |
| Montgomery | 4,326 | (3) | |
| Moore | 12,308 | -- | |
| Morris | W | W | Stone (crushed), iron ore. |
| Motley | 162 | W | Stone (crushed). |
| Nacogdoches | W | W | Clays. |
| Navarro | 2,060 | 1,900 | Do. |
| Newton | W | W | Sand (industrial). |
| Nolan | 44,372 | W | Cement, gypsum, stone (crushed), clays. |
| Nueces | W | W | Cement. |
| Oldham | 2,011 | (3) | |
| Orange | W | W | Cement. |
| Palo Pinto | W | W | Clays. |
| Parker | W | W | Do. |
| Pecos | W | W | Sulfur. |
| Polk | -- | -- | |
| Potter | W | W | Cement, stone (crushed), clays. |
| Randall | (2) | 354 | Stone (crushed). |
| Reeves | W | (3) | |
| Runnels | W | (3) | |
| Rusk | W | W | Clays. |
| San Patricio | W | W | Stone (crushed). |
| San Saba | -- | W | Do. |
| Smith | W | (3) | |
| Somervell | W | (3) | |
| Stonewall | W | W | Gypsum. |
| Tarrant | W | W | Cement, stone (crushed). |
| Taylor | 842 | W | Stone (crushed). |
| Terry | W | W | Sodium sulfate. |
| Tom Green | (2) | W | Stone (crushed). |
| Travis | W | W | Lime, stone (crushed). |
| Uvalde | 545 | W | Stone (crushed). |
| Val Verde | W | W | Do. |
| Van Zandt | W | W | Salt, clays. |
| Victoria | 17,778 | (3) | |
| Walker | W | 1,913 | Stone (crushed), clays. |
| Ward | W | (3) | |
| Washington | (2) | -- | |
| Webb | W | W | Stone (crushed). |
| Wharton | W | W | Sulfur. |
| Williamson | (2) | W | Stone (crushed), stone (dimension). |
| Winkler | W | W | Salt. |
| Wise | 153 | W | Stone (crushed), clays. |
| Wood | W | W | Clays. |
| Yoakum | W | -- | |
| Young | 200 | W | Stone (crushed). |
| Undistributed[4] | 902,529 | 1,079,698 | |
| Sand and gravel (construction) | XX | [e]208,000 | |
| Stone: | | | |
| Crushed | [e]205,000 | XX | |
| Dimension | [r] [e]7,702 | XX | |
| Total[5] | [r]1,547,278 | 1,508,481 | |

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[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No production of nonfuel mineral commodities was reported for counties not listed.

[2]Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[3]Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4]Includes gem stones that cannot be assigned to specified counties and values indicated by symbol W.

[5]Data may not add to totals shown because of independent rounding.

## Table 3.—Indicators of Texas business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 15,329 | 15,779 | 15,989 |
| Total civilian labor force | do | 7,373 | 7,637 | 7,853 |
| Unemployment | do | 507 | 610 | 466 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 303.2 | 262.9 | 269.9 |
| Metal mining[2] | do | 1.3 | .9 | NA |
| Nonmetallic minerals except fuels[2] | do | 7.9 | 7.8 | NA |
| Coal mining[2] | do | 1.0 | 1.0 | NA |
| Oil and gas extraction | do | 292.9 | 253.2 | 260.3 |
| Manufacturing total | do | 1,045.2 | 963.7 | 996.8 |
| Primary metal industries | do | 42.9 | 33.8 | 36.1 |
| Stone, clay, and glass products | do | 44.4 | 45.8 | 48.8 |
| Chemicals and allied products | do | 81.9 | 77.5 | 76.7 |
| Petroleum and coal products | do | 42.8 | 43.8 | 41.9 |
| Construction | do | 431.1 | 424.0 | 430.4 |
| Transportation and public utilities | do | 385.8 | 366.2 | 371.1 |
| Wholesale and retail trade | do | 1,554.1 | 1,554.0 | 1,614.0 |
| Finance, insurance, real estate | do | 369.6 | 394.1 | 414.9 |
| Services | do | 1,150.5 | 1,186.3 | 1,257.5 |
| Government and government enterprises | do | 1,023.6 | 1,042.0 | 1,082.0 |
| Total[3] | do | 6,263.4 | 6,193.6 | 6,436.6 |
| Personal income: | | | | |
| Total | millions | $174,233 | $182,880 | $201,013 |
| Per capita | | $11,366 | $11,590 | $12,572 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 40.0 | 40.9 | 41.7 |
| Mining | | 44.8 | 45.9 | 46.5 |
| Total average hourly earnings, production workers | | $8.60 | $8.88 | $9.04 |
| Mining | | $10.13 | $10.26 | $10.27 |
| Earnings by industry: | | | | |
| Farm income | millions | $1,521 | $1,955 | $2,151 |
| Nonfarm | do | $130,284 | $135,728 | $149,144 |
| Mining total | do | $10,724 | $9,315 | $10,078 |
| Metal mining | do | $28 | $23 | $14 |
| Nonmetallic minerals except fuels | do | $182 | $187 | $184 |
| Coal mining | do | $40 | $41 | $57 |
| Oil and gas extraction | do | $10,474 | $9,063 | $9,823 |
| Manufacturing total | do | $25,300 | $24,588 | $26,708 |
| Primary metal industries | do | $1,242 | $1,011 | $1,116 |
| Stone, clay, and glass products | do | $975 | $1,054 | $1,184 |
| Chemicals and allied products | do | $2,810 | $2,839 | $2,931 |
| Petroleum and coal products | do | $2,079 | $2,129 | $2,182 |
| Construction | do | $10,167 | $10,541 | $11,349 |
| Transportation and public utilities | do | $10,627 | $10,967 | $11,696 |
| Wholesale and retail trade | do | $24,209 | $25,171 | $27,593 |
| Finance, insurance, real estate | do | $7,442 | $9,020 | $10,458 |
| Services | do | $21,974 | $24,461 | $27,696 |
| Government and government enterprises | do | $19,318 | $21,110 | $22,972 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 201,313 | 276,684 | 191,136 |
| Value of nonresidential construction | millions | $6,878.0 | $6,325.4 | $7,111.8 |
| Value of State road contract awards | do | $895.4 | $867.1 | $974.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 9,428 | 10,359 | 11,355 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $1,547.3 | $1,508.5 | $1,715.4 |
| Value per capita | | $101 | $96 | $107 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

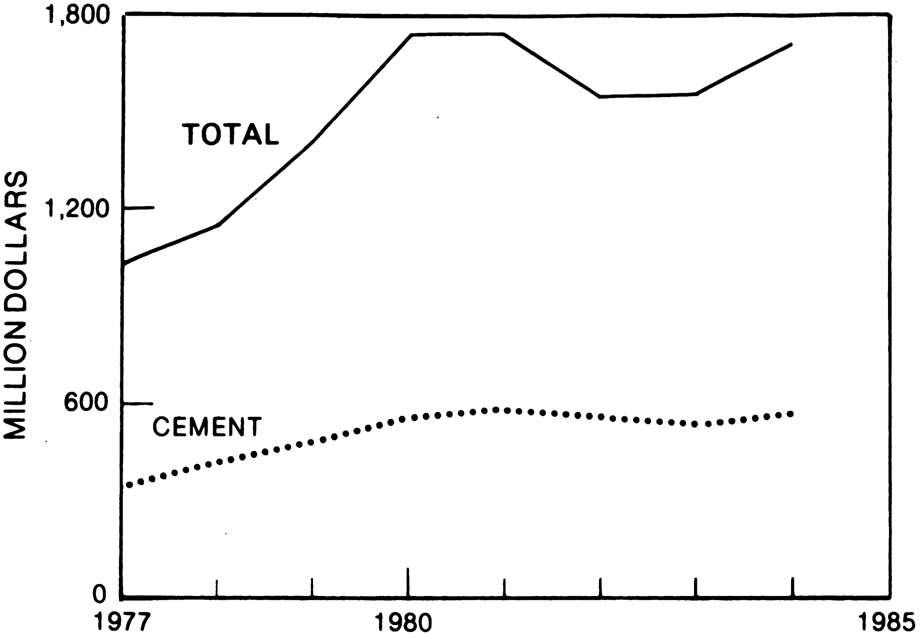

**Figure 1.—Value of cement and total value of nonfuel mineral production in Texas.**

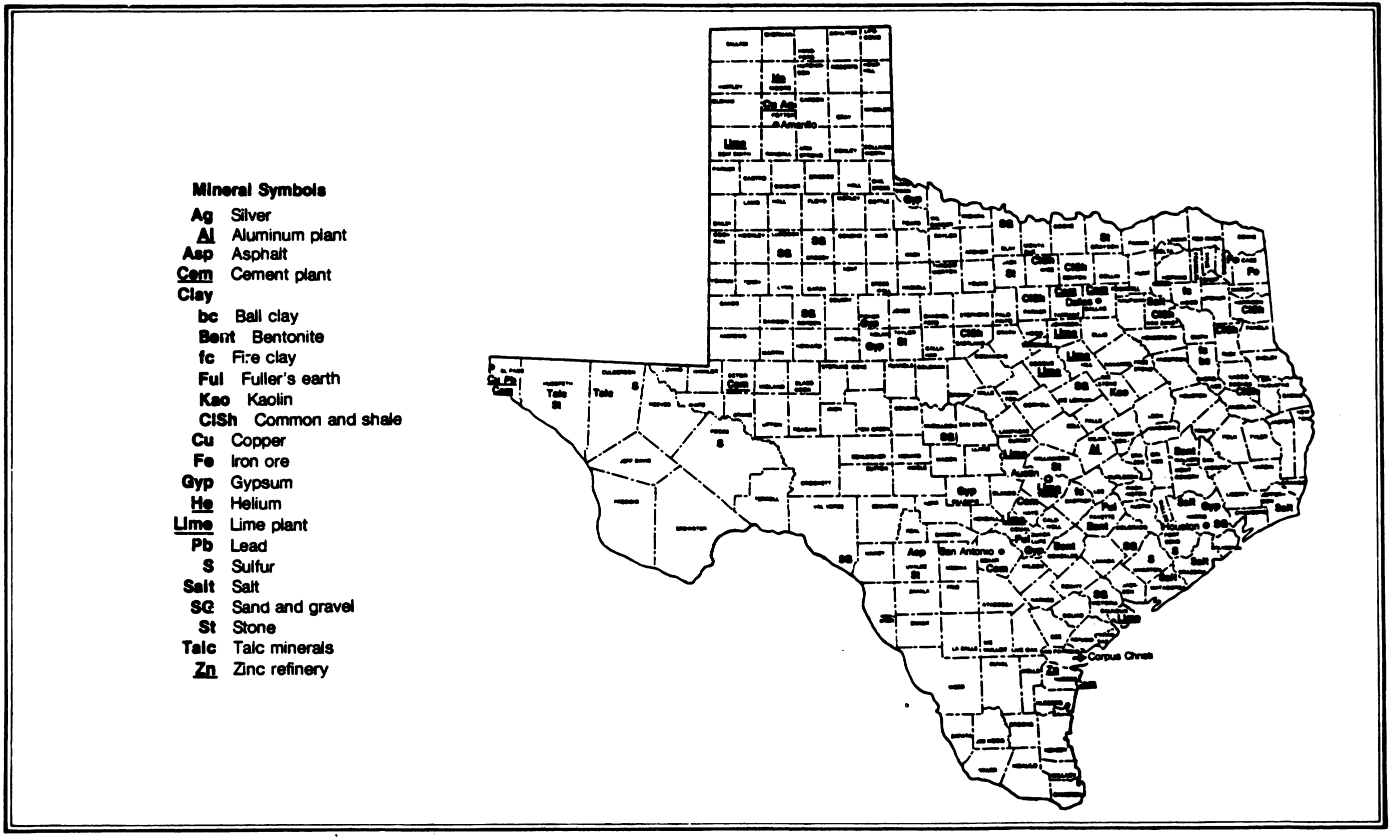

Figure 2.—Principal mineral producing localities in Texas.

**Trends and Developments.**—The trend toward more foreign investment in the U.S. cement industry continued. In Texas, six plants, or one-third of the cement plants in the State, one grinding and distribution center, and one terminal were owned by foreign investors.

Firms dealing in international mineral trading improved or built new dock and storage facilities at Texas ports.

International Minerals & Chemical Corp. built a dry bulk marine terminal at Texas City for petroleum coke, potash, soda ash, and other domestically produced materials, although the operation also was to handle imported materials from overseas. The multimillion dollar facility, constructed on a 93-acre leased site on the Texas City Industrial Canal, became operational October 1, 1984. The location is served by the Missouri-Pacific; the Missouri-Kansas-Texas; the Atcheson, Topeka, and Santa Fe; the Burlington Northern; and the Southern Pacific Railroads.

The Port of Houston, the second largest barite entry port, installed a new $4.1 million shiploading system, including a traveling shiploader, a dust suppression system, and a new conveyor belt scheme, to increase efficiency and improve turnaround time for ships calling at the port.

The Houston potash dock was closed for improvements on October 15 and reopened November 10. Port Arthur and Beaumont were the alternative ports.

Newpark Resources Co. announced its intention to develop a new supply base at Harbor Island near Corpus Christi to furnish fluids (including barite drilling muds) to the offshore petroleum exploration industry in the Gulf of Mexico.

Dun and Bradstreet Corp. estimated population changes between 1980 and 1984 for each of the Nation's 3,123 counties that had populations of 100,000 or more. Fort Bend County, TX, topped the list as the Nation's fastest growing county, up 45.76% in population. Also among the top 25 fastest growing counties were seven other Texas counties: Montgomery, 2d; Denton, 4th; Collin, 5th; Ector, 11th; Travis, 15th; Harris, 17th; and Hidalgo, 18th, each up from 19.61% to as much as 45.47%.

Population shifts and patterns can be expected to influence changes in the mining industry, especially the industrial minerals sector, which includes such quarried materials as sand and gravel, crushed stone, and the components of cement. Demand will rise for other mined and quarried products also used for housing, transportation, medical care, and other correlative growth areas.

**Employment.**—Mining employment, including the oil and gas industry, rose from 290,100 in 1983 to 294,300 in 1984 and was expected to rise to 302,400 in 1985, according to the Texas Comptroller of Public Accounts.[3]

**Environment.**—On January 30, 1984, the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA), the United Steelworkers of America, and ASARCO Incorporated agreed on feasible engineering controls to reduce worker exposure to lead at four of the company's plants, including the smelter at El Paso. OSHA officials were discussing similar agreements with AMAX Inc. and St. Joe Lead Co., the Nation's other leading lead companies. The agreements called for improving ventilation, enclosing some processes or workplaces, increasing cleanup methods, providing filtered-air clean rooms, and conducting research to develop or locate additional controls to further reduce lead exposure.[4]

In early 1984, the Environmental Protection Agency issued a final rule limiting particulate emissions from new plants started after August 24, 1982. The final rule limits the concentration of particulates in stack emissions to 0.05 gram per cubic meter, based on the use of the best demonstrated technology, in this case, high-energy wet scrubbers. Plants affected are those that process metallic ores into concentrates containing one or more of the following: aluminum, copper, gold, iron, lead, molybdenum, silver, titanium, tungsten, uranium, zinc, and zirconium.[5] All were processed in Texas.

The Railroad Commission of Texas, Surface Mining and Reclamation Division, issued a Notice of Violation on June 6, 1984, relating to Aluminum Co. of America's (Alcoa) permit to operate the Sandow lignite surface mine. Sandow provided low-grade coal for the power station servicing the company's Rockdale plant. The notice directed that an amendment to the permit application be filed, specifying a method of reclamation to reduce the high-acid condition at the surface of certain reclaimed mining lands. Conditions that warranted five additional notices to the Sandow surface mine in the third quarter of 1984 had been or were being abated.

**Exploration Activities.**—In February 1984, Wold Minerals Exploration Co. announced a major talc discovery in the west Texas area after a successful exploration and development program. The size of the discovery was not announced. The company held mining patents to more than 20,000 acres of State-owned land in the area.[6]

**Legislation and Government Programs.**—One of three finalists in the Nation chosen by the U.S. Department of Energy (DOE) to be further studied as the Nation's first permanent burial ground for high-level radioactive-waste disposal was a site in Deaf Smith County. Waste would be stored near the farming community of Hereford.

Plans for the waste repository proposed that tunnels be drilled in old and stable salt beds 2,500 feet below a 2,000-acre area. Reaching the salt bed would require that large-diameter shafts be dug through parts of the Ogallala and Santa Rosa aquifers—the main water sources for agriculture on the High Plains.

Critics questioned whether DOE had the technology to drill a shaft of the size necessary and to keep that shaft dry. The question of where to put the 25 million tons of salt removed during excavation of the space needed was also a serious consideration. The schedule called for the President to approve a site and send his nomination to Congress by 1990. After nomination by the President, a State could issue a formal "notice of disapproval" of the site.[7]

In March, the U.S. Congress approved Interstate Cost Estimate legislation that gave the U.S. Department of Transportation authority to disburse collected Federal Highway Trust Fund construction funds to the States. The action was 6 months late and released only one-half of the funds available; their late release affected the demand for crushed stone.

In a rehearing of Moser et al. versus United States Steel Corp. et al., in June, the Texas Supreme Court withdrew a 1983 opinion that ruled that near-surface uranium deposits (being produced in situ) belonged to the holder of the mineral estate. In Texas, the mineral and surface estates may be separated by conveyance, and longstanding tradition in Texas had held that near-surface minerals were a part of the surface estate.[8]

The U.S. Bureau of Mines provided some funding for the Texas Mining and Mineral Resources Research Institute, which supported graduate research in mining and related topics at The University of Texas at Austin and at the Texas A & M University at College Station.

The institute also supported research by the Bureau of Economic Geology on the mineral resources of Texas. Projects included the geology of occurrences of various metals in the Trans-Pecos area, lignite in east Texas, bituminous coal in north-central Texas, and the occurrence and production of industrial minerals in Texas.

The Bureau of Land Management paid $929,648 in lieu of taxes to local Texas governments for tax-exempt Federal lands. Only 2.1% of land in Texas is owned by the Federal Government.

In December 1984, the Texas Water Development Board adopted rules regulating large-bore drilled or mined shafts, pursuant to Texas Senate Bill 1018. In general, new facilities with "very large diameter" boreholes and shafts, and which penetrate either a major or minor aquifer of usable quality ground water, will require a permit from the Texas Department of Water Resources. The three existing facilities in the State that might have been affected were exempt from the orders.

Public hearings on rules to regulate the mining of iron ore and iron ore gravels were held by the Surface Mining and Reclamation Division of the Railroad Commission of Texas, but no regulations had been published by yearend.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Ammonia (Anhydrous) and Urea.**—According to its 1984 annual report, Cominco American Incorporated produced anhydrous ammonia and urea at its fertilizer plant at Borger, Hutchinson County, and delivered ammonia through a 900-mile pipeline to its terminals as well as to the ammonium nitrate fertilizer plant at Beatrice, NE. With improved markets, the production of anhydrous ammonia and urea at Borger returned to normal levels in 1984.

A $45 million project to increase the volume of ammonia and reduce the energy required to produce it was under study. Benefits foreseen included a reduction of waste disposal volumes. At yearend, the Borger plant employed 81 workers and had produced 326,600 metric tons of ammonia and 70,200 metric tons of urea, up from 218,500 metric tons and 46,900 metric tons, respectively, in 1983.

**Asphalt.**—Bituminous limestone, used primarily as a paving material for street and road repair, was produced in Uvalde County by White's Mines Inc. and Azrock Industries Inc. In June, Azrock was purchased by the R. L. White Co. The geologic unit is Anacacho Limestone, a coarse-grained, fossiliferous limestone impregnated with asphalt. Extensive surface and near-surface deposits are in parts of Medina and Kinney Counties, as well as Uvalde County, all west of San Antonio.

Native asphalt was produced only in Texas and Utah and was valued at about $8.75 per short ton.

**Cement.**—Reflecting growth in construction and building and continued improvement in the domestic economic outlook, portland cement total production and value increased 6.8% and 4.3%, respectively; however, average value per short ton decreased. Masonry cement production increased 5.4%, and total value rose 23.9%.

Portland cement was produced at 18 plants and masonry cement at 12 plants during 1984. The average value of portland cement shipped in 1984 was $53.48 per short ton. The average value of masonry cement shipped was $83.87, about $12.50 per ton more than in 1983. Finished portland cement shipments to terminals were made almost entirely by rail.

Ready-mixed concrete companies used 58.5% of the finished portland cement produced, followed, in decreasing order of amount used, by contractors, concrete product manufacturers, building material dealers, highway contractors, miscellaneous customers, and government agencies.

During the year, the local industry operated 33 kilns having a total clinker production capacity of 30,082 short tons of cement per 24 hours. Seventeen kilns were the wet-process type and 16 were the dry process. Nine plants used suspension preheaters.

The industry consumed 8.2 million tons of limestone and smaller amounts of anhydrite, cement rock, clay, clinker, fly ash, gypsum, iron ore, marl, mill scale, sand, shale, and various acids, oils, resins, and caustic soda.

Natural gas was the major fuel used to heat kilns; 1,881,440 thousand cubic feet (Mcf) of this fuel was consumed during the year, 22% less than in 1983. For air pollution control, 14 fiberglass baghouses and 16 electric precipitators were used.

Foreign ownership of Texas cement companies was significant: Alamo Cement Co., 650,000-short-ton clinker capacity, owned by Presa S.p.A. Cementeria di Robilante (Italy) and Vigier Cement Ltd. (Switzerland); General Portland Inc., three plants in Texas, clinker capacity combined with other General Portland plants in six States, and a grinding and distribution terminal in Texas, owned by Lafarge Coppee (France); Lehigh Portland Cement Co., one plant in Waco, clinker capacity combined with eight Lehigh plants, owned by Heidelberger Zement AG (Federal Republic of Germany); and River Cement Co., one plant, clinker capacity combined with one other River Cement plant, owned by Instituto Financiere Industriale S.p.A. (Italy). The terminal, with a capacity of 300,000 short tons of clinker, was owned by Falcon Cement Co. of the Saudi Research and Development Corp. (Saudi Arabia).[9]

To serve the Dallas area, Box-Crow Cement Co., formerly Dal-Tex Cement Corp., created a new 1-million-ton-per-year plant northwest of Midlothian, Ellis County.[10]

Capitol Cement Div. of Capitol Aggregates Inc. added a new 500,000-short-ton-per-year, dry-process kiln line at its San Antonio plant, increasing the annual clinker production capacity to 830,000 tons. Gifford-Hill & Co. Inc. added production of oil well cement at its Midlothian plant. Lafarge bought a cement terminal at Corpus Christi.

Expansion was begun in October 1984 at Southwestern Portland Cement Co.'s Odessa plant. The installation of an additional finish mill and related facilities at an estimated cost of $10 million was scheduled for completion in 1985 and would increase capacity by approximately 25%.

Southwestern Portland's El Paso cement market was affected by Mexican imports in 1984, and a decision was made to remove from service the kilns at the small, high-cost El Paso plant in early 1985 and, at least temporarily, utilize the facility as a grinding and distribution terminal for imported Mexican clinker and cement.

The estimated clinker capacity of each of the three Southwestern Portland plants was Odessa, 527,000 tons; El Paso, 257,000 tons; and Amarillo, 230,000 tons, amounting to 25.3% of the firm's capacity. Shipments from these three plants were 14% above those of 1983.

Southwestern Portland was a wholly owned subsidiary of Southdown Inc. of Houston, which stated in its 1984 annual report that Southwestern Portland's operating earnings throughout the company were up more than 100% over those of 1983.

**Table 4.—Texas: Masonry cement salient statistics**

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 12 | 12 |
| Production | 281,585 | 291,746 |
| Shipments from mills: | | |
| Quantity | 276,197 | 291,022 |
| Value | $19,704,492 | $24,408,725 |
| Stocks at mills, Dec. 31 | 27,005 | 27,369 |

**Table 5.—Texas: Portland cement salient statistics**

(Short tons unless otherwise specified)

| | 1983 | 1984 |
|---|---|---|
| Number of active plants | 19 | 18 |
| Production | 9,652,005 | 10,321,445 |
| Shipments from mills: | | |
| Quantity | 9,760,372 | 10,423,083 |
| Value | $534,298,379 | $557,421,275 |
| Stocks at mills, Dec. 31 | 555,593 | 609,643 |

**Clays.**—Clays sold or used in the State decreased 9% in total tonnage, but increased 2% in value, and Texas retained its position as the second ranking clay producer in the Nation.

The State's 30 companies operated 68 pits in 32 of its 254 counties: 54 pits produced common clay and shale; 1 each, ball clay, fuller's earth, and kaolin; 9, bentonite; and 2, fire clay.

The six top-ranking companies each produced more than 100,000 short tons of clay and accounted for 78% of accumulated output and 56% of total value.

Although Texas held its place as the Nation's major producer of common clay and shale, output declined 8% from that of 1983. The State ranked fifth of 15 that produced bentonite, but output decreased 17% from that of 1983. Fire clay and fuller's earth production fell by nearly one-half and two-thirds, respectively.

Texas ranked fourth of seven States that produced ball clay, output increasing 56% over that of 1983. Kaolin output and average value increased 15% and 50%, respectively, compared with those of 1983.

Only those upward changes in ball clay and kaolin output and value followed the nationwide trends.

The largest manufacturer in the Nation of vitrified clay sewer pipe and an innovator in the use of clay products was Dickey Co., which had facilities at San Antonio and Texarkana.[11]

Elgin-Butler Brick Co. was converting its gas-fired kilns to coal with the aid of National Synfuels Inc. of Jacksonville, FL, which was designing a traveling-bed gasifier to produce natural gas from lignite associated with Elgin-Butler's clay mining operation in Bastrop County. The $1.6 million project was expected to produce a competitive low-Btu gas that would help to reduce firing costs.

A. P. Green Refractories Co., a subsidiary of United States Gypsum Co., added a new production facility at its Sulphur Springs plant, Hopkins County. The company constructed a 40,000-square-foot addition to the plant to manufacture a line of clay-alumina mortars, plastic refractory products, and high-alumina firebrick.[12]

Justin Industries Inc. of Fort Worth sold its Sanford Brick Corp. to a privately held North Carolina company.[13] Marshall Pottery, one of the Nation's largest manufacturers of clay flower pots as well as other ceramic ware, was sold to a group of east Texas investors. Texas Brick Co. shut down all operations at its Brownwood plant in 1984. Texeramics Inc., Mineral Wells, was expanding its operations under new management that took over the plant in late 1984.

The Building Advisory Council of Texas began a full-time program aimed at emphasizing the importance of noncombustible building materials, especially brick in walls, floors, and roofs of low-rise multifamily constructions.

Clays ranged in value from $4.51 per short ton of common clay and shale to $83.51 per short ton of kaolin, and averaged $6.41.

**Table 6.—Texas: Clays sold or used by producers, by kind**

(Thousand short tons and thousand dollars)

| Year | Ball clay, fuller's earth, kaolin | | Bentonite | | Fire clay | | Common clay and shale | | Total[1] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value |
| 1980 | 123 | 5,953 | 109 | 7,061 | 57 | 743 | 3,475 | 13,265 | 3,763 | 27,022 |
| 1981 | 112 | 5,251 | 116 | 8,265 | 42 | 259 | 3,902 | 15,359 | 4,172 | 29,135 |
| 1982 | 114 | 5,036 | 100 | 5,161 | 38 | 234 | 3,940 | 16,067 | 4,193 | 26,497 |
| 1983 | 123 | 4,985 | 75 | 2,876 | 44 | 288 | 3,714 | 14,427 | 3,955 | 22,575 |
| 1984 | 101 | 6,573 | 62 | 926 | 24 | 190 | 3,407 | 15,362 | 3,594 | 23,051 |

[1] Data may not add to totals shown because of independent rounding.

**Fluorspar.**—D&F Minerals Co. shipped more than double the quantity of metallurgical-grade fluorspar than it shipped in 1983. All came from stocks at its Paisano Mines, south of Alpine, Brewster County. Metallurgical-grade fluorspar was used primarily as a flux by the iron and steel industry.

Oglebay Norton Co. completed modification of its fluorspar grinding plant at Brownsville. The new equipment allowed the company to process fluorspar for the fiberglass, glass, and ceramic industries, as well as the steel industries. None of the raw ore material was mined in Texas.

**Gem Stones.**—Texas gem stones consist of agates, some petrified palmwood, and very small amounts of topaz. Variegated flint reportedly was sold at local gem shows and flea markets. Agates are found in several Texas localities, but the Tertiary volcanics of Brewster County are the prime source. Petrified palmwood is found in the fluvial-deltaic facies of several outcropping Tertiary formations in the interior gulf coastal plain. Topaz is found in granitic pegmatites in Mason County. Texas produced $175,000 worth of gem stones during the year.

**Gypsum.**—In response to lower interest rates and a pent-up demand for housing, Texas gypsum producers had a very good year.

Texas led the Nation in output of crude gypsum, accounting for 15% of the total. In descending order, producing companies were U.S. Gypsum at Sweetwater, Nolan County; Georgia-Pacific Corp. at Quanah, Hardeman County; National Gypsum Co., at Kennedy, Stonewall County; Genstar Building Products Materials Co. at Sweetwater, Nolan County; Fredericksburg Gypsum Co. at Cherry Mountain, Gillespie County; National Gypsum at Harper Quarry, Kimble County; and Southwestern Portand Cement, in the Finlay Mountains, Hudspeth County.

Texas companies supplied 10% of the Nation's calcined gypsum. Calcined gypsum was produced at National Gypsum's Rotan plant, Fisher County; at Windsor Gypsum Co.'s plant in Guadalupe County; at Georgia-Pacific's Acme plant in Hardeman County; at U.S. Gypsum's Galena Park plant in Harris County; and at U.S. Gypsum's and Genstar Building Products Materials' Sweetwater plants, Nolan County.

Total value of calcined gypsum rose 19.8% over that of 1983; average value rose from $17.80 per short ton in 1983 to $20.26 in 1984.

Republic Gypsum Co. of Dallas made gypsum wallboard and paperboard, reporting that its fiscal fourth-quarter earnings, ending June 30, 1984, more than quadrupled from the previous year. The company acquired two paperboard mills in December 1983, and strong demand for the company's products accounted for the increase.

U.S. Gypsum's Sweetwater production capacity recently was increased by 50%, making it one of the two largest gypsum wallboard plants in the world. The plant produces enough gypsum board each year to furnish the wallboard requirements of 80,000 conventional single-family houses.

The Sweetwater plant's new high-speed production line is more than 1,500 feet long and has a normal operating speed of 250 feet per minute. The gypsum board consists of a calcined gypsum slurry sandwiched between two multilayered sheets of paper, with subsequent setting of the plaster as it moves down the line. The company makes the special board paper at several paper mills across the Nation, and Sweetwater's paper was supplied by its Galena Park mill in Harris County.

The Sweetwater plant supplied Texas and New Mexico and parts of Arkansas, Colorado, and Oklahoma where housing demands are expected to remain high. The plant and quarry occupied a total of 3,850 acres, and the quarry has a substantial reserve of high-quality rock. In 1983, 22 persons worked at the quarry.[14]

**Helium.**—Crude helium production increased 57.6% over that of 1983. Helium was extracted from natural gas produced from the Hugoton, Panhandle, and Cliffside Gasfields in Texas and adjoining States.[15] Extraction plants were the U.S. Bureau of Mines' Exell plant at Masterson and the Phillips Petroleum Co. plant at Dumas, both in Moore County, and Phillips' second plant, in Hansford County.

Government facilities include, in addition to the extraction operation, purification facilities, a 500-liter-per-hour helium liquefier, a conservation pipeline and storage system, and associated distribution facilities and equipment.

Helium is used in breathing mixtures (deep-sea diving), welding (undersea oil and gas pipeline operations), in controlled atmospheres (crystal growing), as a lifting gas (balloons), in chromatography (the analysis of gases, etc.), in leak detection, and as a heat transfer medium. Helium, both as a gas and liquid, also was in demand in national defense, space, and energy development projects.

Grade-A helium output increased 13.9% over that of 1983. Grade-A gaseous helium has been sold by the U.S. Bureau of Mines for $37.50 per Mcf since October 1, 1982; private producers offered Grade-A helium at about $36 per Mcf. Liquid helium averaged $55 per Mcf gaseous equivalent, plus surcharges.

Contractors constructed a warehouse, a tank-car maintenance and testing facility, and helium storage facilities, at the Bureau's Exell plant.

**Lime.**—Texas produced 1.2 million short tons of lime and accounted for 7% of total lime output. Only five other States produced more than 1 million tons each. Production in 1984 increased 8% over that of 1983. The number of operating lime plants fell from nine in 1983 to eight in 1984. During the year, Armco Inc.'s Azbe vertical lime kiln in Houston was dormant.

Average value of Texas lime decreased from $56.41 to $52.91 per short ton.

Leading firms were Chemical Lime Co. Inc., with one plant at Clifton, Bosque County, and another at Marble Falls, Burnet County; and U.S. Gypsum, with one plant at New Braunfels, Comal County. Other companies operated lime plants in Bexar, Deaf Smith, Hill, Johnson, and Travis Counties. All produced quicklime, and six of the eight plants produced hydrated lime.

Texas produced 10% of the Nation's lime used for water purification, 11% of lime for electric-furnace steel production, 14% for mason's lime, and 74% for road and soil stabilization. Texas was a leading consumer of hydrated lime, almost 550,000 tons, mostly used for road and soil stabilization.

Table 7.—Texas: Lime sold or used by producers, by use

| Use | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity (short tons) | Value (thousands) | Quantity (short tons) | Value (thousands) |
| Road stabilization | 366,177 | $21,605 | 413,242 | $23,394 |
| Soil stabilization | 127,768 | 6,865 | 135,278 | 7,119 |
| Water purification | W | W | 134,216 | 7,002 |
| Steel, electric | 106,528 | 5,275 | 100,746 | 4,531 |
| Paper and pulp | W | W | 46,926 | 2,481 |
| Mason's lime | W | W | 32,931 | 1,842 |
| Food (animal and human) | 1,532 | 83 | W | W |
| Other[1] | 464,555 | 26,365 | 293,432 | 14,845 |
| Total | 1,066,560 | 60,193 | 1,156,771 | 61,214 |

W Withheld to avoid disclosing company proprietary data, included with "Other."

[1] Includes acid water neutralization, aluminum and bauxite, agriculture, basic oxygen furnace steel, finishing lime glass (1983), magnesium, oil and grease (1984), oil well drilling, open-hearth steel, other chemical and industrial uses petrochemicals (1983), petroleum refining, sewage treatment, sugar refining, and uses indicated by symbol W.

**Magnesium Compounds.**—Magnesium compounds produced in Texas during 1984 were at the same level of production and value as in 1983. The Dow Chemical Co. produced caustic-calcined magnesia and magnesium hydroxide from its seawater magnesium operation at Freeport in Brazoria County, one of about half a dozen operations in the Nation to produce magnesium hydroxide. Output at the Freeport facility was below annual production capacity o 75,000 short tons of MgO equivalent.

**Perlite (Expanded).**—Texas ranked sixt of 32 producing States in the output o expanded perlite, even though no perlit was mined within the State. Seven plant reported activity in 1984. Plants were those of South Texas Perlite Co. in Bexar County; Pamrod Products, Comal County; W. R. Grace & Co., Dallas County; Perlite Houston Inc. and Filter & Media Co., Harris County; U.S. Gypsum, Nolan County; and Sil-Flo Inc., Tarrant County.

Expanded perlite was used as aggregate for concrete, plaster, and horticultural uses; in formed products; in cavity-fill and low-temperature insulation; and as fillers and filter aids. The average value of expanded perlite sold and used in 1984 increased to $214.36 per short ton, compared with $207.92 in 1983; output decreased insignificantly from that of 1983.

**Salt.**—In 1984, as in 1983, Texas ranked second in the Nation in quantity of salt sold or used. Eight companies in the State produced 21% of the national output. Approximately 90% of the output was produced by brine operations, and a significant portion was consumed as brine. Rock salt was obtained from underground mines at Grand Saline salt dome in east Texas and from Hockley salt dome near Houston. Three gulf coast salt domes support brining operations, but most of the brine was produced from bedded salt in the Permian Basin area of west Texas. About two-thirds of the State's salt output was produced from Brazoria County.

Value received for Texas salt ranged from a low of $2.72 to a high of $101.26 per short ton; average value was $8.51 per short ton, $0.33 higher than in 1983.

The Texas Bureau of Economic Geology published a volume on east Texas salt domes.[16]

**Sand and Gravel.**—Of the State's 254 counties, 85 produced construction sand and gravel, and 1 produced industrial sand and gravel.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend. Compared with estimated figures for 1983, construction sand and gravel production in 1984 increased 6.6% in reported output and decreased 4% in reported total value. Value per short ton declined from $3.56 in 1983 to $3.20 in 1984. A total of 162 firms operated 234 pits during 1984. More than 1 million short tons each was produced by 11 firms from a combined total of 50 pits.

Gifford-Hill produced concrete aggregate at its new sand and gravel plant at Benchley, northwest of Bryan, from its high-fines deposit in the flood plain of the Brazos River.[17]

Texas Industries Inc.'s Texas Aggregate Div. added a 300-ton-per-hour aggregate plant recently to meet growing sand and gravel demand in the Austin area.[18]

In decreasing order of volume, construction sand and gravel was used in concrete aggregate, fill, road base and coverings, asphaltic concrete, plaster and gunite sands, concrete products, and miscellaneous. Average value for all uses was $3.20 per short ton.

Nearly 90% of construction sand and gravel was transported by truck from 222, or 95%, of the pits.

**Table 8.—Texas: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 25,467 | $94,228 | $3.70 |
| Plaster and gunite sands | 564 | 2,673 | 4.74 |
| Concrete products | 218 | 1,016 | 4.67 |
| Asphaltic concrete | 1,971 | 7,837 | 3.98 |
| Road base and coverings[1] | 3,002 | 9,449 | 3.15 |
| Fill | 3,831 | 6,424 | 1.68 |
| Other[2] | 27,337 | 77,832 | 2.85 |
| Total[3] or average | 62,389 | 199,461 | 3.20 |

[1] Includes road and other stabilization (lime).
[2] Includes other unspecified uses.
[3] Data may not add to totals shown because of independent rounding.

*Industrial.*—Industrial sand and gravel output increased 13% but decreased nearly 1% in value from those of 1983.

Texas Mining Co., a wholly owned subsidiary of Oglebay Norton, produced fracture sand for use by gas and oil well service companies. Texas Mining reported approximately 98.7 million short tons of silica sand reserves, on about 515 acres, at Voca, McCulloch County, according to Oglebay Norton's 1984 10K Annual Report submitted to the Securities and Exchange Commission.

Oglebay Norton's 1984 10K Annual Report also revealed that crushing and new washing facilities at Voca have an annual capacity of approximately 3 million tons of crude sand. The crushed and washed sand was transported to a dry-screening plant at a railhead at Brady. The dry-screening plant has the capacity to process 1.25 million tons of washed sand annually, about 50,000 tons of which is pulverized for use by the building materials industry.

Vulcan Materials Co. produced frac sand (oil and gas well proppant sand) at its 400,000-ton-per-year plant near Voca. The plant was a joint venture of Vulcan's South Div. (aggregates) and its Chemicals Div.[19]

Industrial sand and gravel was used for blasting abrasives, chemicals, glass containers, flat glass, fiberglass (unground), fillers (ground), filtration, hydraulic fracturing, foundry molding and core, pottery and porcelain, roofing granules, metallurgical silicon carbide, and engine traction. Average value for all uses was $14.44, although values ranged from a low of $3 for an unspecified use to a high of $63.48 for metallurgical silicon carbide.

**Sodium Sulfate.**—Production and value of sodium sulfate from subterranean brines in the Texas Panhandle increased from those of 1983. Ozark Mahoning Co., a subsidiary of Pennwalt Corp., operated facilities at Brownfield, Terry County, and Seagraves, Gaines County. The Seagraves sodium sulfate plant was being expanded and modernized. The project, scheduled for completion in 1985, was to increase capacity by 43%, to 155,000 tons per year.[20]

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—Texas crushed stone producers increased production and led the Nation in estimated output; production represented 9.3% of the national total.

Pioneer Aggregate, a subsidiary of Affiliated Aggregate, purchased active quarries and development acreage for limestone and sand and gravel from Lone Star Industries Inc. The ownership change involved operations primarily in the north Texas area.

*Dimension.*—Texas dimension stone output declined 7% from that of 1983. Leading producing companies were Texas Granite Co. (a subsidiary of Cold Spring Granite Co.) and Capitol Marble & Granite Co. Inc. A review of current industry practice indicated that use of dimension stone in building increased substantially in the 1980's because of stone's attractiveness, durability, superior insulation qualities, and because dimension stone had become less expensive compared with glass and steel, but particularly because of the development of new installation techniques.[21]

**Sulfate of Potash.**—Sulfate of potash was produced at two Texas plants operated by Permian Chemical Corp. and Potash Co. of America.

**Sulfur.**—*Frasch.*—Frasch sulfur production in Texas again increased over that of 1983. In 1984, production was up 21% over that of 1983; in 1983, it had risen 5% over that of 1982. The strong surge in demand represented increased production and use of fertilizers.

In decreasing order of output, producers were Duval Corp.'s mine in Culberson County, Texasgulf Chemicals Co.'s Newgulf sulfur mine on the Boling salt dome in Wharton County, and Farmland Industries Inc.'s Fort Stockton site in Pecos County. These three Texas mines were the source of 55% of the Nation's Frasch sulfur production.

The average value nationwide was $109.20 per metric ton of Frasch sulfur, compared with $108.28 in 1983.

Texas Frasch sulfur is from two distinctly different geological settings. Duval's operation, Farmland Industries, and Texasgulf Chemicals' Pecos County site are in bedded evaporites, whereas other Texas operations, such as Boling Dome and Moss Bluff, are in the caprock of coastal salt domes.

Pennzoil Co.'s sulfur operations were organized into a separate subsidiary at yearend 1984.[22] Renamed Pennzoil Sulphur Co., the new subsidiary was retained by Pennzoil after its divestiture of other mining assets because sulfur exploration and production had proved to be a good fit with the company's other activities.

Pennzoil's mining subsidiary, Duval, operated the Western World's largest Frasch sulfur property, in Culberson County, in west Texas.

Proven ore reserves at Culberson were approximately 36.6 million metric tons at yearend 1984, according to the company's 10K Annual Report.

Sulfur from the Culberson County mine was transported by railroad to Pennzoil's terminal in Galveston and shipped either in bulk form for export or as a liquid in tankers to Tampa, FL.

Pennzoil used natural gas to superheat the water used in melting the sulfur and forcing it to the surface, and had long-term gas production committed to the sulfur operation. The company realized substantial savings through productivity improvements at Culberson during 1984. As strong demand continued in the worldwide fertilizer market, Pennzoil's sulfur sales were 49% above those of 1983, and were only 7.5% behind sales in 1980.

Texasgulf Chemicals' Frasch sulfur production from Newgulf, Wharton County, was about 415,000 metric tons in 1984, up 5% over that of 1983. In its 56th year of operation, the Newgulf Mine brought its cumulative production to 80.2 million metric tons, the most productive sulfur mine in the world.[23]

Construction of a 70-megawatt cogeneration plant at Newgulf began in April 1984 and was expected to be completed in 12 months at a cost of about $30 million. The new plant was to generate electricity for sale and use the waste heat to provide hot water for the Frasch mining process, allowing Newgulf to begin a new period of low-cost sulfur production.

Texasgulf Chemicals' Comanche Creek Mine in Pecos County, 14 miles northeast of Fort Stockton—a high-cost mine that was closed in December 1983—remained on standby throughout 1984. Sulfur was melted from Comanche Creek aboveground inventories and sent by rail to Texasgulf Chemicals' phosphate operations at Lee Creek, NC. Texasgulf Chemicals' sulfur shipping terminal at Beaumont was in service during 1984.

At yearend, all producers except Texasgulf Chemicals (a division of Texasgulf Inc., which in turn is a subsidiary of Elf Aquitaine Inc.) were earnestly seeking maximum production rates.

**Table 9.—Texas: Sulfur produced and shipped from Frasch mines**

(Thousand metric tons and thousand dollars)

| Year | Production | Shipments | |
|---|---|---|---|
| | | Quantity | Value |
| 1980 | 4,081 | 4,810 | W |
| 1981 | 3,908 | 3,674 | W |
| 1982 | 2,898 | 2,360 | W |
| 1983 | 1,915 | 2,468 | W |
| 1984 | 2,257 | 2,994 | W |

W Withheld to avoid disclosing company proprietary data.

*Recovered.*—Texas led the nation in producing recovered elemental sulfur; shipments from the State accounted for more than 27% of total shipments nationwide. Elemental sulfur was recovered as a byproduct of petroleum refining in 29 counties. Most came from Harris, Henderson, and Jefferson Counties in eastern Texas—sites of plants owned by America Petrofina Inc., Atlantic Richfield Co., Charter International Oil Co., Crown Central Petroleum Corp., Exxon USA, E. I. du Pont de Nemours & Co., Gulf Oil Corp., Mobil Oil Corp., Shell Oil Co., Smackover Shell Ltd., and Union Oil Co. of California.

**Talc.**—Crude talc ore has been produced from mines in the Allamore mining district of Culberson and Hudspeth Counties since the 1950's. Known talc deposits extend westward from Tumbledown Mountain mining district (west of Van Horn) about 20 miles to the Eagle Flat mining district. (See also "Exploration Activities" section.)

In decreasing order of short tons produced, the companies were Texas Talc Co., a subsidiary of Dal-Tile Corp.; Southern Clay Products Inc.; Pioneer Talc Co. Inc.; Westex Minerals Co., a subsidiary of Milwhite Inc.; and Milwhite Co. Inc. Texas Talc was one of the Nation's six largest producers of talc.

Talc is used in the manufacture of ceramic tile and as an additive in paint and paper.

**Zeolites.**—Ethyl Corp. produced detergent-grade zeolite at its 100,000-short-ton-per-year plant at Pasadena, Harris County. Where phosphates have been either limited or banned by State legislatures or other government bodies, zeolites have replaced, and may increasingly replace, phosphates in home laundry detergents. Some zeolites are used also as desiccants and adsorbents.

## METALS

**Primary Smelters and Refineries.**—Texas began the year with two primary aluminum smelters, two aluminum refineries, two copper smelters, one copper rod mill, one copper refinery, and one lead smelter; a zinc refinery was reopened early in the year. Byproducts from copper and lead smelting and refining were antimony, cadmium, gold, palladium, selenium, silver, and tellurium.

**Aluminum.**—Texas ranked fourth of 17 States that had primary aluminum production facilities, up from fifth of 17 in 1983. Production in Texas in 1984 rose 7%, and value increased 23% over that of 1983. The economic recovery of mid-1983 had encouraged producers to start up potlines, but by January 1984, metal prices began to decline and world aluminum metal inventories to increase. By June, producers, in an effort to offset the downward price trend, began to reduce production, and, by December, one potline had been shutdown.

Alcoa operated only the eight-potline primary aluminum plant at Rockdale in Milam County, having indefinitely shut down its Palestine smelter in Anderson County in July 1982.

At a rated annual capacity of 310,000 metric tons, Rockdale accounted for more than 7% of the Nation's total aluminum capacity; however, Alcoa had shut down one 34,000-metric-ton-per-year potline of the eight at Rockdale by December 1984; it had been restarted only in September.

In October, Alcoa sold its 30% share of the partially completed Twin Oak Steam Electric Station and related mining equipment and certain lignite reserves to subsidiaries of Texas Utilities Co. The sale of the facilities and reserves, in Robertson County, resulted in a gain of $33 million ($25 million after taxes), according to the company's 1984 annual report.

A major program began in 1984 to update and improve three electric generating units at the Sandow power facility, Milam County, and a fourth unit was to be added later. Sandow, operated by Texas Utilities Electric Co. under a contract that expires not earlier than 2011, supplied power to the Rockdale smelter using locally mined lignite. Lignite reserves, either owned or under lease at Rockdale, are estimated to be sufficient for operation at capacity consumption rates until at least 2011, according to the company's 10K Annual Report.[24]

Rockdale began producing aluminum powders used in rocket propellants and powder metallurgy applications. On February 3, 1984, the space shuttle *Challenger* blasted off with the aid of Alcoa's atomized powder produced at Rockdale. It was the first time this powder had been used in a space shuttle launching.[25]

The Alcoa Technical Center refined a process called electromagnetic casting (EMC) that was to be installed at Rockdale in late 1985. EMC, patented by Licensintorg, forms aluminum ingot within an electromagnetic force field (rather than in a mold), producing ingot with smooth, blemish-free surfaces that require little preparation before fabricating. The process also generates less scrap. EMC was expected to bring major savings through the reduction of ingot scalping and edge trimming.

Alumina was supplied to Rockdale either by Alcoa's plants at Point Comfort, TX, and Paranam, Suriname, or by its joint-venture plant in Clarendon Parish, Jamaica. The company's bauxite sources were Saline County, Arkansas; Boke, Guinea, on the west coast of Africa; and Jamaica, the Dominican Republic, and Moengo and Onverdacht, Suriname, in the Caribbean Sea area.

Point Comfort modified its alumina refining process in 1983 to reduce energy consumption and lower production costs and began operating its sixth bauxite digester. With fine tuning in 1984, the modification continued to reduce the plant's unit energy and production costs.

In 1983, Point Comfort expanded its growing chemicals business by adding high-quality calcined aluminas used in refractories to its product line.

Alcoa reached an agreement with ARCO Metals Co. in 1983 to further develop technology to produce aluminum chloride economically for use as a feedstock in the Alcoa smelting process. The new technology uses kaolin clay—which, unlike bauxite, is readily available in the United States—as the raw material for the Alcoa smelting process. The first research and development phase was nearing completion and the company was evaluating several alternatives at yearend 1984, according to Alcoa's 10K Annual Report.

The 15,000-metric-ton-per-year Palestine smelter, which had closed indefinitely in July 1982, was the first commercial-size plant based on the Alcoa smelting process. The process has a potential for significant energy savings and environmental improvements, greater than those of the traditional Hall process. Aluminum production at Palestine began in 1976, and, although the smelting cells exceeded expectations, the chemical plant that provided the aluminum chloride for the cells required further research and development.

Alcoa closed its insulated electrical conductor plant in Marshall, Harrison County, in 1983 after workers rejected wage and benefit concessions that might have made the plant competitive. The plant was later purchased by a corporation partly owned by some of its former employees.

Alumax Inc. announced plans to build a $150 million can sheet-rolling mill in Texarkana, Bowie County. The plant was expected to be operational in mid-1986, with about 70,000 tons per year of can sheet capacity. Some of the material for the rolling mill was to come from a 7,000-ton-per-year beverage-container recycling plant that Alumax planned to build in Texas.

Reynolds Metals Co. permanently shut down its 103,000-metric-ton-per-year San Patricio primary aluminum plant at Corpus Christi in February 1984, citing the recession and high energy costs, particularly that of natural gas. The plant, which started up in 1952, last operated at full capacity in early 1980, and metal production stopped altogether in May 1981. Its closure reduced the company's total rated capacity from 1,043,000 to 940,000 metric tons per year, reduced Texas' annual smelter capacity from 428,000 metric tons per year to 325,000 metric tons, and reduced U.S. capacity to about 4.9 million metric tons at yearend 1984.

Reynolds refined bauxite into alumina at its Sherwin plant near Corpus Christi. Rated capacity at yearend 1984 at the alumina plant was 1.7 million metric tons. Energy at the plant was provided by natural gas.

**Antimony.**—Antimony metal was recovered from tetrahedrite copper concentrates at Asarco's El Paso copper smelter.

**Cadmium.**—Cadmium was produced as a byproduct of zinc production at Asarco's Corpus Christi refinery and at a cadmium fume recovery unit in conjunction with the lead smelter at Asarco's El Paso plant.

**Chromium.**—Bell Helicopter Textron Inc., Fort Worth, reported in the spring of 1984 that it had adopted the U.S. Bureau of Mines' technology for regenerating the waste chromic acid solutions used in etching metals to produce finished surfaces. Previously, the common practice was to discard the spent etching solutions daily, losing the chromium values they contained and also adding to manufacturing costs because of the extra caution required in disposing of harmful wastes. U.S. Bureau of Mines' technology has been applied by industry in recycling chromium, reducing the Nation's dependence on imports of the critical metal, and solving a serious waste-disposal problem.

**Cobalt.**—Gulf Chemical & Metallurgical Corp. recovered significant amounts of cobalt from spent hydroprocessing catalysts at its Freeport plant.

**Copper and Lead.**—*Primary Smelters.*—Texas smelter and refinery production of copper and lead increased in 1984, compared with production in 1983. Secondary smelter capacity also operated during the year at increased levels.

Asarco's Amarillo copper refinery increased its operating rate to about 85% of its 376,500-metric-ton capacity for most of 1984, from 55% in late 1983 and early 1984, but continued to be affected by shortages of raw materials, particularly copper scrap. The company planned to step up copper cathode output from the designed 31,750 metric tons to 35,000 metric tons per month by May 1985.

The increased capacity was possible owing to the greater electric current efficiency provided by use of Asarco's patented Reatrol process and was being achieved without any expansion of existing facilities or any significant capital expenditure. The Reatrol process, which controls addition agents in electrolytic refining solutions, had been used at Amarillo since 1980, and since then has continued to generate savings in excess of $1 million per year.

Asarco's 97-year-old El Paso copper and lead smelter—actually two smelters, because the metals require different processing—processed purchased and custom toll concentrates from both foreign and domestic sources. Foreign materials, in order of volume, were primarily drawn from as far away as Peru, Australia, and Canada, but lesser quantities were from Honduras, Mexico, and Tasmania. Copper plant input was 14% foreign; lead plant input was 57% foreign. Products in 1984 were 81,600 metric tons of copper anodes ("blister" in company's annual report, p. 11), 43,700 metric tons of lead bullion, 270 metric tons of antimony, and 296,000 short tons of sulfuric acid.

El Paso shipped its lead bullion to Asarco's Omaha, NE, refinery. At yearend, the El Paso smelter employed 844 persons and had an operating budget of $91 million, including salaries and purchases, according to an April 25, 1985, Asarco news release.

The largest end use for Asarco's El Paso copper anodes was in telecommunications, followed by building supplies and automobile components. The biggest use of lead was in batteries. Antimony was used primarily as a fire retardant in clothing. Seventy percent of the sulfuric acid produced by Asarco at El Paso was used in the fertilizer industry; the remainder was used by various chemical plants.

Labor contracts with the International Brotherhood of Electrical Workers and the United Steelworkers of America were to expire at Asarco's El Paso and Amarillo smelters June 30, 1986.

Phelps Dodge Refining Corp.'s El Paso refinery, with a capacity of approximately 381,000 metric tons of electrolytic copper per year, processed 340,380 metric tons, including 1 or 2 months of Laurel Hill, NY, production, according to the company's 1984 10K Annual Report. After closing its Laurel Hill refinery in February 1984, Phelps Dodge expected the El Paso refinery to meet projected refining needs over the next several years.

A strike, from July 1, 1983, throughout 1984, curtailed production at the El Paso facility, and workers voted in September 1984 to oust the United Steelworkers of America as their bargaining agent. About 300 new hires had been declared eligible to vote by the National Labor Relations Board in the union decertification election held in September; union employees who had been on strike at El Paso since July 1983 were permanently expunged from the rolls and declared ineligible.

The Phelps Dodge El Paso facility included a continuous cast rod mill capable of converting annually approximately 386,000 metric tons of refined copper into rod. Rod was sold to outside wire and cable manufacturers for use in the construction, electric utility, communications, and transportation industries, and in industrial machinery and equipment, consumer products, and a variety of other electrical and electronic applications. The copper rod mill operated on an approximate 5-day, 3-shift basis throughout 1983 and 1984.

Phelps Dodge also recovered gold and silver during the copper refining, as well as copper sulfate, and small amounts of byproduct palladium, platinum, selenium, and tellurium from refining slimes.

*Secondary Smelters.*—Federated Metals Corp., a wholly owned subsidiary of Asarco, was restructured in 1984 to place primary emphasis on the profitable electronic solder business rather than on recycling of nonferrous scrap, according to Asarco's 1984 annual report. In exchange for its San Francisco plant and other working capital and equipment at its Newark, NJ, and Houston plants, Federated Metals acquired a 20% interest in Fry Metals Inc., a major producer of solders and related products for the electronics market, and was renamed Federated Fry Metals Corp. The Houston plant was scheduled to close in 1985, and a $2 million charge for that closing was recorded in Asarco's 1984 results. The cathodic protection business and Lone Star Lead Construction Corp. at the Houston plant were to be relocated to smaller facilities. These closures and curtailments substantially reduced salaried and hourly personnel as well as overall operating costs to the parent company, Asarco.

In May, RSR Corp., the Nation's largest secondary lead producer, sold its 65,000-ton-per-year smelter-refinery at Dallas to Murmur Corp., under divestiture ordered by the Federal Trade Commission. The plant had been shut down by RSR since the end of February and did not come back on-stream during the year, owing to environmental cleanup and legal problems.

**Germanium.**—Refined germanium products were produced by Rare Materials International Inc., formerly Bunker Rare Metals, at Irving, Dallas County. Germanium was used in infrared systems, fiber optics, gamma-ray, X-ray, and infrared detectors, and in semiconductors.

**Gold.**—No gold was produced from Texas ores, but significant amounts of gold were recovered at Texas smelters and refineries from out-of-State ores.

Asarco refined gold at its Amarillo plant. A new process for parting gold at the refinery started up in August and significantly reduced the amount of gold tied up in other byproducts of copper refining. Gold output in 1984 amounted to 339,800 troy ounces, according to the company's annual report.

Phelps Dodge produced gold at its El Paso copper refinery, but production figures for January through February were combined with those for the Laurel Hill, NY, refinery; after February, Laurel Hill was closed.

**Iron Ore.**—Texas was 1 of 10 States to ship usable iron ore in 1984. Output and value increased about 10% and 46%, respectively, over those of 1983. Lone Star Steel Co., Morris County, restarted iron ore mining and pig iron production in January, following a 15-month shutdown. In August 1984, Lone Star Steel announced plans to add a metallurgical test facility to the Morris County plant.[26]

Mathis & Mathis Mining & Exploration Co. and Hudson Bros. Mining Co. Inc. also mined iron ore from surface pits in Cass and Cherokee Counties. Hudson Bros. was the largest producer, followed by Lone Star and Mathis & Mathis.

**Iron and Steel.**—Armco operated its Houston works for almost 42 years before closing it officially on January 27, 1984. Operating capacity had been 1.5 million tons of steel per year; the plant employed 4,200 people. The site for the plant was on the Houston Ship Channel, a convenient, inexpensive water route that brought in ore, coal, and scrap and took out steel products.

The North Star Steel Co. steel minimill at Beaumont, purchased from Korf Industries Inc. in 1983, produced wire rod. The mill's program in expanding production of high-carbon rod was not as good as the company hoped for in 1984. To spur the move into more high-carbon rod production, the firm requested funds for a ladle metallurgy station to be built, probably after the middle of 1985.

The mill maximized freight advantages by shipping to the gulf coast and the Midwest by riverways. North Star Steel Texas, a subsidiary of North Star Steel Corp., undertook a 2-year, $25 million program to incorporate high-technology processes into the Texas minimill. By June 1985, North Star Steel Texas planned to complete a $3 million modernization of the plant's rolling mill. Improvements to the melt shop, including installation of eccentric bottom tapping and continuous casting modifications, were next on the list.

NUCOR Corp.'s Nucor Steel Div. operated a steel mill at Jewett, Leon County. The mill produced both carbon and alloy steels from steel scrap melted in electric arc furnaces and poured into continuous casting billet systems. The company's Vulcraft Div. plant at Grapeland, in adjacent Houston County, was the Nation's largest producer of joists and joist girders, used extensively in manufacturing large buildings, according to the company's annual reports for 1983 and 1984.

**Magnesium.**—Dow Chemical produced magnesium chloride for magnesium metal from its Brazoria County facility. The 1984 level of production increased more than 39% over that of 1983, and Texas continued to be the major producer in the Nation.

**Manganese.**—American Minerals Inc. operated its grinding plant at El Paso mainly to provide a coloring agent to the brick industry in the Southern States but secondly to supply fertilizer-quality manganese to the agricultural market. The plant was built at El Paso because 90% of the ore being ground in early days was from adjacent Mexico. During more recent times, manganese ore from the U.S. Government stockpile at Deming, NM, less than 100 miles northwest of El Paso, has been the main source of material for the plant. American Minerals also processed iron chromite, barite, and fluorspar.

**Molybdenum.**—Gulf Chemical & Metallurgical, a division of Associated Metals and Minerals Corp., recovered significant amounts of molybdenum from spent hydroprocessing catalysts at its Freeport plant in 1984.

**Selenium.**—Texas was the Nation's leading producer of metallic selenium. Primary selenium was recovered from both domestic and imported materials at copper refineries at Amarillo and El Paso. Phelps Dodge installed selenium refining facilities at its El Paso plant and began refining and stockpiling crude selenium materials in early 1984. Asarco received shipments of selenium-bearing copper slimes at its Amarillo plant from other domestic copper refineries and either processed or exported the slimes.

Selenium is used in electronic and photocopier components, as a decolorant in glass manufacturing, in pigments ranging in color from light orange to maroon, for plastics, glass, and ceramics, in metallurgical applications, and in animal feed and chemicals.

**Silver.**—Asarco's El Paso lead smelter was an important producer of silver contained in lead bullion. Silver was separated from the lead bullion at the company's Omaha, NE, lead refinery and from anode copper at its Amarillo copper refinery. The separated silver from both plants was refined at the Amarillo refinery; output in 1984 amounted to 46,356,000 troy ounces, according to Asarco's 1984 annual report.

**Tellurium.**—Tellurium was a byproduct of primary copper production. Commercial-grade tellurium metal was recovered from copper anode slimes during electrolytic refining at Asarco's Amarillo refinery. Tellurium's principal use was as an alloying metal in the production of free-machining steels. In combination with mercury and cadmium, tellurium forms an infrared sensing material for thermal-imaging devices.

**Vanadium.**—Gulf Chemical & Metallurgical produced vanadium pentoxide ($V_2O_5$) from spent hydroprocessing catalysts at its Freeport facility in Brazoria County. The product—technical-grade vanadium pentoxide—was 98% $V_2O_5$ minimum, usually containing 0.5%, maximum, molybdenum as an impurity, and was used in the manufacture of ferroalloys. Gulf Chemical & Metallurgical sold 362,000 pounds of $V_2O_5$ valued at $839,840 to the Federal stockpile in 1984.

**Zinc.**—Asarco's Corpus Christi electrolytic zinc refinery, closed since October 30, 1982, began recalling workers on February 16 and began producing metal in May 1984. Reopening was made possible by the general improvement in economic conditions that affect the zinc refining industry, especially in housing construction and automobile manufacture, and by the conclusion of labor negotiations with the United Steelworkers of America. Wage concessions and a 2-year suspension of cost-of-living adjustments were parts of the negotiated agreement. The refinery employed 275 workers at the time production resumed.

The Corpus Christi refinery had accounted for 26% of domestic primary zinc capacity; when it closed, owing to a lack of feed and depressed zinc prices, the refinery was operating at only 50% of capacity. When production resumed, it operated at about 5,500 metric tons per month, or 56% of its 104,000-metric-ton-per-year capacity.

At yearend, however, the company's 1984 annual report stated that a decision had been made to suspend operations at Corpus Christi indefinitely in early April 1985 because of declining prices and high costs. Asarco's slag-fuming plants at El Paso, TX, and East Helena, MT, were expected to be closed permanently because the company wrote off all of their asset value against 1984 results.[27]

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[2] Geologist, Bureau of Economic Geology, The University of Texas at Austin, TX.

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### Table 10.—Texas: Primary smelters, refineries, and reduction plants

| Product, company, plant | Location (county) | Material treated |
|---|---|---|
| Aluminum: | | |
| Aluminum Co. of America: | | |
| Rockdale (reduction) | Milam | Bauxite. |
| Reynolds Metals Co.: | | |
| San Patricio (reduction) | San Patricio | Do. |
| Sherwin plant (alumina) | do | Do. |
| Antimony: | | |
| ASARCO Incorporated: | | |
| El Paso smelter | El Paso | Ore. |
| Cadmium: | | |
| ASARCO Incorporated: | | |
| Electrolytic | Nueces | Do. |
| Copper: | | |
| ASARCO Incorporated: | | |
| Amarillo refinery[1] | Potter | Blister and anode. |
| El Paso smelter | El Paso | Ore and concentrates. |
| Phelps Dodge Refining Corp.: | | |
| Nichols refinery[2] | do | Blister and anode. |
| Iron: | | |
| Armco Inc.: | | |
| Houston plant | Harris | Ore and scrap. |
| Lone Star Steel Co.: | | |
| Daingerfield plant | Morris | Do. |
| Tex-Iron Inc.: | | |
| Larue operations | Henderson | Ore. |
| United States Steel Corp.: | | |
| Baytown plant | Chambers | Ore and scrap. |
| Lead: | | |
| ASARCO Incorporated: | | |
| El Paso smelter | El Paso | Ore and concentrates. |
| Magnesium: | | |
| The Dow Chemical Co.: | | |
| Freeport plant, electrolytic | Brazoria | Seawater. |
| Zeolites: | | |
| Ethyl Corp | do | Salt. |
| Zinc: | | |
| ASARCO Incorporated: | | |
| Corpus Christi electrolytic[3] | Nueces | Ore and concentrates. |
| El Paso fuming plant | El Paso | Dusts and residues. |

[1] Asarco's Amarillo refinery also produced gold, nickel sulfate, palladium, platinum, selenium, silver, and tellurium.

[2] Phelps Dodge's El Paso (Nichols) refinery also produced copper sulfate, gold, palladium, platinum, selenium, silver, and tellurium.

[3] Asarco's Corpus Christi refinery also produced sulfuric acid and cadmium.

### Table 11.—Texas: Secondary metal recovery plants

| County and company | Material | Product |
|---|---|---|
| Bexar: | | |
| River City Steel & Recycling Co | Scrap metal | Smelter and refined scrap metals. |
| Brazoria: | | |
| Texas Reduction Corp | Aluminum scrap | Alloyed aluminum ingot. |
| Collin: | | |
| GNB Batteries Inc | Lead scrap | Battery lead oxide, pig lead. |
| Dallas: | | |
| Dixie Metals Co | do | Lead pigs, alloys, chemicals. |
| Laclede Steel Co | Steel scrap | Reinforcing steel. |
| RSR Corp | Lead scrap | Lead shot, solders, lead pipe. |
| El Paso: | | |
| Border Steel Rolling Mills Inc | Steel scrap | Reinforcing bars, bar shapes, steel grinding balls. |
| Proler International Corp | do | Precipitation iron. |
| llis: | | |
| Chaparral Steel Co | do | Steel reinforcing bars and shapes. |
| Industrial Metals Co | Scrap metal | Metal shapes and ingots. |
| Gregg: | | |
| Marathon-LeTourneau Co | Steel scrap | Steel castings and shapes. |
| Southwest Steel Castings Co | do | Steel castings. |
| Guadalupe: | | |
| Structural Metals Inc | do | Structural steel reinforcing bars. |
| Harris: | | |
| A & B Metal Manufacturing Co. Inc | Scrap metal | Tungsten carbide. |
| Federated Fry Metals Corp | Various metals | Lead ingot, solder, copper tubing, bearing metals, sheet lead, lead pipe. |
| Gulf Reduction Corp | Aluminum zinc scrap | Aluminum and zinc ingots, and alloys. |
| Houston Lead Co | Lead scrap | Lead pigs, ingots, alloys. |
| Lead Products Co. Inc | do | Do. |
| Proler International Corp | Various metals | Zinc slab, aluminum alloys, precipitation iron. |

## Table 11.—Texas: Secondary metal recovery plants —Continued

| County and company | Material | Product |
|---|---|---|
| Jefferson: | | |
| Georgetown Texas Steel Corp | Steel scrap | Steel rods and shapes. |
| Leon: | | |
| NUCOR Corp., Nucor Steel Div | do | Do. |
| San Antonio: | | |
| Standard Industries | Lead scrap, soft lead, drosses | Battery metals, grids, oxides. |
| Smith: | | |
| Bloch Metals Inc | Aluminum scrap | Aluminum ingots. |
| Tyler Pipe Industries Inc | Steel scrap | Pipe and pipe fittings. |
| Tarrant: | | |
| Texas Steel Co | do | Carbon and alloy steel bars and shapes, reinforcing bars. |

## Table 12.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Asphalt (native): | | | |
| Azrock Industries Inc | 84 NE. Loop 410<br>Suite 480 W<br>San Antonio, TX 78216 | Quarry and plant | Uvalde. |
| White's Mines Inc.[1] | Box 32688<br>San Antonio, TX 78216 | do | Do. |
| Barite: | | | |
| Dresser Industries Inc | Box 6504<br>Houston, TX 77265 | Grinding plants | Cameron and Galveston. |
| Milwhite Co. Inc.[2] | 5801 Lyons Ave.<br>Houston, TX 77020 | do | Cameron and Harris. |
| NL Industries Inc | Box 1675<br>Houston, TX 77001 | do | Nueces. |
| Cement: | | | |
| Alamo Cement Co | Box 6925<br>San Antonio, TX 78209 | Quarry and plant | Bexar. |
| Centex Cement Corp., a subsidiary of Centex Corp. | 4600 Republic Bank Tower<br>Dallas, TX 75201 | Quarries and plants | Hays and Nueces. |
| General Portland Inc | 12700 Park Central Pl.<br>Dallas, TX 75251 | do | Bexar, Dallas, Tarrant. |
| Gifford-Hill & Co. Inc | Box 520<br>Midlothian, TX 76065 | Quarry and plant | Ellis. |
| Southwestern Portland Cement Co. | Box 392<br>El Paso, TX 79943 | Quarries and plants | Ector, El Paso, Potter. |
| Texas Industries Inc.[3] | 8100 Carpenter Freeway<br>Dallas, TX 75247 | do | Comal and Ellis. |
| Clays: | | | |
| Acme Brick Co., a division of Justin Industries Inc. | Box 886<br>Denton, TX 76202 | Pits and plants | Denton, Guadalupe, Henderson, Nacogdoches, Parker, Van Zandt, Wise. |
| Elgin-Butler Brick Co | Box 1947<br>Austin, TX 78767 | Pit and plant | Bastrop. |
| Featherlite Building Products Corp. | Box 141<br>Ranger, TX 76470 | do | Eastland. |
| Henderson Clay Products Co | Box 490<br>Lindale, TX 75771 | Pits and plants | Cherokee, Ellis, Harrison, Rusk. |
| Southern Clay Products Inc | Box 44<br>Gonzales, TX 78629 | do | Gonzales and Henderson. |
| Texas Clay Industries Inc | Box 469<br>Malakoff, TX 75148 | Pit and plant | Henderson. |
| Gypsum: | | | |
| Genstar Building Products Materials Co. | Box 2580<br>Irving, TX 75061 | Quarry and calcining plant. | Nolan. |
| Georgia-Pacific Corp | 133 Peachtree St. NE.<br>Atlanta, GA 30303 | do | Hardeman. |
| National Gypsum Co | 2001 Rexford Rd.<br>Charlotte, NC 28211 | Quarries and calcining plants. | Fisher, Kimble, Stonewall. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Harris and Nolan. |
| Windsor Gypsum Co | McQueeney, TX 78123 | do | Guadalupe. |
| Iron ore: | | | |
| Hudson Bros. Mining Co. Inc | Box 301<br>Rusk, TX 75785 | Mine | Cherokee. |
| Lone Star Steel Co | Box 35888<br>Dallas, TX 75235 | Mines | Cass and Morris. |
| Mathis & Mathis Mining & Exploration Co. | 1101 Santa Rita<br>Box 2577<br>Silver City, NM 88062 | Mine | Cass. |

See footnotes at end of table.

## Table 12.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Lime: | | | |
| Austin White Lime Co | Box 9556<br>Austin, TX 78766 | Plant | Travis. |
| Chemical Lime Co. Inc | P.M. Hwy. 2602<br>Clifton TX 76634 | Plants | Bosque and Burnet. |
| Holly Sugar Corp | Drawer 1778<br>Hereford, TX 79045 | Plant | Deaf Smith. |
| Redland Worth Corp | Route 2, Box 222<br>San Antonio, TX 78229 | do | Bexar. |
| Round Rock Lime Co., a subsidiary of Dravo Lime Co. | Box 38<br>Blum, TX 76627 | do | Hill. |
| Texas Lime Co., a subsidiary of Rangaire Corp. | Box 851<br>Cleburne, TX 70631 | do | Johnson. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Comal. |
| Salt: | | | |
| Diamond Shamrock Corp | 717 North Harwood<br>Dallas, TX 75201 | do | Chambers. |
| The Dow Chemical Co.[4] | 2020 Dow Center<br>Midland, MI 48640 | Brine | Brazoria. |
| Morton Thiokol Inc | 110 North Wacker Dr.<br>Chicago, IL 60606 | Underground mine and brine. | Van Zandt. |
| Texas Brine Corp | 2000 West Loop South<br>Houston, TX 77027 | Brines | Harris, Jefferson, Matagorda. |
| Sand and gravel: | | | |
| Capitol Aggregates Inc. a subsidiary of H. B. Zachry Co. | Drawer 33240<br>San Antonio, TX 78265 | Stationary plants | Bexar, Freestone, Travis, Val Verde. |
| Centex Materials Inc | Box 2252<br>Austin, TX 78768 | Pits and plants | Hays and Travis. |
| The Fordyce Co | Box 1981<br>San Antonio, TX 78297 | do | Hidalgo and Victoria. |
| Gifford-Hill & Co. Inc | Box 47127<br>Dallas, TX 75247 | do | Brazos, Colorado, Dallas, Ellis, McLennan. |
| Lone Star Industries Inc.[5] | Box 47327<br>Dallas, TX 75247 | do | Colorado, Dallas, Liberty, Montgomery, Nolan, Wise. |
| Oglebay Norton Co., Texas Mining Co. | 2212 Arlington Downs Rd.<br>Suite 103<br>Arlington, TX 76011 | Pits and plant | McCulloch. |
| Parker Bros. & Co. Inc | Box 107<br>Houston, TX 77001 | Stationary plants and dredge. | Colorado, Fayette, Harris, Victoria. |
| Pennsylvania Glass Sand Corp | Box 187<br>Berkeley Springs, WV 25411 | Pits | Live Oak and McCulloch. |
| Thorstenberg Materials Co. Inc., a division of Ideal Basic Industries Inc. | 363 North Belt No. 540<br>Houston, TX 77054 | do | Colorado and Fayette. |
| UNIMIN Corp | 50 Locust Ave.<br>New Canaan, CT 06840 | Plant | Johnson. |
| Sodium sulfate (natural): | | | |
| Ozark-Mahoning Co | 1870 South Boulder<br>Tulsa, OK 74119 | Plants | Gaines and Terry. |
| Stone: | | | |
| General Portland Inc | 2800 Republic Bank Tower<br>Dallas, TX 75201 | Quarries | Dallas, Tarrant, Wise. |
| Gifford-Hill & Co. Inc.[6] | Box 47127<br>Dallas, TX 75247 | do | Comal, Ellis, Hudspeth, Wise. |
| Lone Star Industries Inc | Box 47327<br>Dallas, TX 75247 | do | Burnet, Nolan, Wise. |
| Parker Bros. & Co. Inc | Box 107<br>Houston, TX 77001 | Quarry | Comal. |
| Texas Crushed Stone Co | Box 1000<br>Georgetown, TX 78626 | do | Williamson. |
| Texas Industries Inc | Box 146<br>Midlothian, TX 76065 | Quarries | Comal, Ellis, Jack, Wise. |
| Vulcan Materials Co.[7] | Box 13010<br>San Antonio, TX 78213 | do | Bexar, Grayson, Wise. |
| Sulfur: | | | |
| Byproduct: | | | |
| Amoco Production Co | Box 591<br>Tulsa, OK 74102 | Secondary recovery | Andrews, Ector, Hockley, Van Zandt, Wood. |
| Exxon Chemical Americas, a subsidiary of Exxon Corp. | Box 77253-3272<br>Houston, TX 77079 | do | Atacosa and Harris. |
| Gulf Oil Co | Box 701<br>Port Arthur, TX 77640 | do | Crane, Hopkins, Jefferson, Karnes. |
| Phillips Petroleum Co | Bartlesville, OK 74003 | do | Andrews, Brazoria, Hutchinson. |
| Smackover Shell Ltd | Rte. 2, Box 152<br>Eustace, TX 75124 | do | Henderson. |
| Texaco Producing Inc | Box 8<br>Scroggins, TX 75480 | do | Franklin and Freestone. |

See footnotes at end of table.

## Table 12.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Sulfur —Continued | | | |
| Native: | | | |
| Duval Corp | 1906 First City National Bank<br>Houston, TX 77002 | Frasch mine | Culberson. |
| Farmland Industries Inc | Box 850<br>Fort Stockton, TX 79735 | do | Pecos. |
| Texasgulf Chemicals Co., a subsidiary of Elf Aquitaine Inc. | Glenwood at Glen Eden<br>Box 30321<br>Raleigh, NC 27622-0321 | Frasch mines | Pecos and Wharton. |
| Talc: | | | |
| Pioneer Talc Co. Inc | Chatsworth, GA 30705 | Pits and plant | Hudspeth. |
| Southern Clay Products Inc | Box 44<br>Gonzales, TX 78629 | do | Do. |
| Texas Talc Co., a subsidiary of Dal-Tile Corp. | Box 17130<br>Dallas, TX 75217 | Pits | Do. |
| Westex Minerals Co., a subsidiary of Milwhite Co. Inc. | Box 15038<br>Houston, TX 77020 | Mine and plant | Culberson. |
| Vermiculite: | | | |
| W. R. Grace & Co | 2651 Manila Rd.<br>Dallas, TX 75200 | Exfoliating plants | Bexar and Dallas. |
| Vermiculite Products Inc | Box 7327<br>Houston, TX 77008 | Exfoliating plant | Harris. |

[1] Also stone, Brown, Parker, Taylor, and Uvalde Counties.

[2] Also clay and shale, Fayette and Walker Counties.

[3] Also clays, Ellis, Fort Bend, Guadalupe, and Navarro Counties; sand and gravel, Colorado, Dallas, Denton, Ellis, Parker, Tarrant, and Travis Counties.

[4] Also magnesium compounds, Brazoria County.

[5] Also cement, Nolan County.

[6] Also clays, Ellis County.

[7] Also industrial sand, McCulloch County.

# The Mineral Industry of Utah

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Utah Geological and Mineral Survey for collecting information on all nonfuel minerals.**

**By Lorraine B. Burgin**[1]

The value of nonfuel mineral production declined from $657 million in 1983 to $524 million in 1984. Metal production fell to less than two-thirds of the total value of nonfuel mineral output because of low metal prices and the corresponding drop in copper, gold, silver, and vanadium production. In contrast, the total value of nonmetals output rose because of a record increase in construction activity.

Utah's principal commodities, in decreasing order of value, were copper, gold, portland cement, construction sand and gravel, silver, salt, potassium salts, phosphate rock, lime, crushed and broken stone, native asphalt (gilsonite), sulfuric acid, and molybdenum.

Nationally, the State ranked first in gilsonite and beryllium hydroxide production; second in potassium salts and magnesium metal; third in copper, gold, and vanadium; and fifth in molybdenum, phosphate rock, and silver.

**Table 1.—Nonfuel mineral production in Utah**[1]

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Beryllium concentrate short tons | W | W | 6,030 | $6 |
| Clays[2] thousand short tons | 227 | $1,569 | 315 | 2,223 |
| Copper (recoverable content of ores, etc.) metric tons | 169,751 | 286,403 | W | W |
| Gem stones | NA | 80 | NA | 80 |
| Gold (recoverable content of ores, etc.) troy ounces | 238,459 | 101,107 | W | W |
| Gypsum thousand short tons | 305 | 2,736 | 277 | 2,671 |
| Lime do | 315 | 16,771 | 297 | 16,471 |
| Salt do | 936 | 23,184 | 1,246 | 28,651 |
| Sand and gravel: |  |  |  |  |
| Construction do | $^{e}$9,800 | $^{e}$19,800 | 15,217 | 34,507 |
| Industrial do | 24 | W | 11 | W |
| Silver (recoverable content of ores, etc.) thousand troy ounces | 4,567 | 52,242 | W | W |
| Stone: |  |  |  |  |
| Crushed thousand short tons | 4,407 | 14,636 | $^{e}$5,200 | $^{e}$16,400 |
| Combined value of asphalt (native), cement, clays (fuller's earth), iron ore (usable, 1983), lead (1984), magnesium compounds, molybdenum, perlite (1983), phosphate rock, potassium salts, sodium sulfate, stone (dimension, 1983), vanadium, zinc (1984), and values indicated by symbol W | XX | 138,051 | XX | 423,153 |
| Total | XX | 656,579 | XX | 524,162 |

$^{e}$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Utah, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Beaver | $132 | (2) | Stone (crushed). |
| Box Elder | W | W | Stone (crushed), salt, silver. |
| Cache | W | W | Stone (crushed). |
| Carbon | W | $13 | Do. |
| Daggett | (3) | 6 | Do. |
| Davis | 2,126 | (2) | |
| Duchesne | 528 | 1 | Do. |
| Emery | 352 | (2) | |
| Garfield | W | 62 | Stone (crushed). |
| Grand | W | W | Potassium salts, salt. |
| Iron | 19,284 | 28,197 | Silver, iron ore, stone (crushed), gold. |
| Juab | 8,858 | W | Cement, stone (crushed), gypsum, clays. |
| Kane | W | 2 | Stone (crushed). |
| Millard | 5,135 | W | Lime, stone (crushed), perlite, gypsum, beryllium. |
| Morgan | W | W | Cement, stone (crushed). |
| Salt Lake | 425,137 | W | Copper, gold, silver, cement, molybdenum, salt, stone (crushed), sand and gravel (industrial). |
| San Juan | W | W | Vanadium. |
| Sanpete | W | W | Gypsum, clays, stone (crushed). |
| Sevier | 2,326 | 2,504 | Gypsum, salt, clays. |
| Summit | W | W | Clays, stone (crushed). |
| Tooele | 19,259 | 36,978 | Gold, lime, salt, potassium salts, stone (crushed), magnesium compounds, clays, silver, copper. |
| Uintah | 24,934 | W | Phosphate rock, stone (crushed and broken). |
| Utah | 5,575 | 1,473 | Stone (crushed), clays, gold, silver. |
| Wasatch | 368 | 54 | Stone (crushed). |
| Washington | 778 | 180 | Do. |
| Weber | 42,966 | W | Potassium salts, salt, magnesium compounds, sodium sulfate. |
| Undistributed[4] | [r]48,530 | 567,309 | |
| Sand and gravel (construction) | XX | [e]19,800 | |
| Stone: | | | |
| Crushed | [e]9,800 | XX | |
| Dimension | W | XX | |
| Total | [r] [5]616,092 | 656,579 | |

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[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] Piute, Rich, and Wayne Counties are not listed because no nonfuel mineral production was reported.

[2] Construction sand and gravel was produced; data were not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Crushed and dimension stone (1982) was produced; data were not available by county. Total State values are shown separately under "Stone."

[4] Includes asphalt (native), gem stones, and perlite (1982), that cannot be assigned to specific counties, and values indicated by symbol W.

[5] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Utah business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 1,571 | 1,618 | 1,652 |
| Total civilian labor force | do | 676 | 694 | 721 |
| Unemployment | do | 53 | 64 | 47 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 18.2 | 14.0 | 12.7 |
| Metal mining | do | 6.6 | 5.5 | 4.2 |
| Nonmetallic minerals except fuels[2] | do | 1.0 | .9 | NA |
| Coal mining | do | 5.2 | 3.2 | 2.8 |
| Oil and gas extraction[2] | do | 5.4 | 4.5 | NA |
| Manufacturing total | do | 85.7 | 85.5 | 94.2 |
| Primary metal industries | do | 6.8 | 5.8 | 5.7 |
| Stone, clay, and glass products[2] | do | 3.6 | 3.6 | NA |
| Chemicals and allied products[2] | do | 3.9 | 3.5 | NA |
| Petroleum and coal products | do | 1.0 | .9 | NA |
| Construction | do | 26.9 | 28.7 | 35.0 |
| Transportation and public utilities | do | 35.4 | 35.9 | 36.4 |
| Wholesale and retail trade | do | 132.0 | 133.5 | 140.9 |
| Finance, insurance, real estate | do | 26.6 | 28.0 | 29.8 |
| Services | do | 109.7 | 112.5 | 121.3 |
| Government and government enterprises | do | 126.4 | 128.8 | 131.1 |
| Total | do | 560.9 | 566.9 | 601.4 |
| Personal income: | | | | |
| Total | millions | $13,685 | $14,593 | $16,074 |
| Per capita | | $8,709 | $9,021 | $9,783 |

See footnotes at end of table.

## Table 3.—Indicators of Utah business activity —Continued

| | | 1982r | 1983 | 1984p |
|---|---|---|---|---|
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.8 | 39.6 | 40.3 |
| Mining | | 42.6 | 41.7 | 43.2 |
| Total average hourly earnings, production workers | | $9.40 | $9.74 | $9.93 |
| Mining | | $11.88 | $12.48 | $12.26 |
| Earnings by industry: | | | | |
| Farm income | millions | $85 | $89 | $106 |
| Nonfarm | do. | $10,167 | $10,799 | $11,983 |
| Mining total | do. | $587 | $463 | $449 |
| Metal mining | do. | $207 | $193 | $156 |
| Nonmetallic minerals except fuels | do. | $25 | $22 | $21 |
| Coal mining | do. | $186 | $121 | $125 |
| Oil and gas extraction | do. | $168 | $127 | $147 |
| Manufacturing total | do. | $1,848 | $1,940 | $2,250 |
| Primary metal industries | do. | $235 | $203 | $219 |
| Stone, clay, and glass products | do. | $78 | $85 | $110 |
| Chemicals and allied products | do. | $67 | $67 | $79 |
| Petroleum and coal products | do. | $39 | $40 | $42 |
| Construction | do. | $633 | $692 | $849 |
| Transportation and public utilities | do. | $974 | $1,067 | $1,120 |
| Wholesale and retail trade | do. | $1,690 | $1,797 | $1,975 |
| Finance, insurance, real estate | do. | $443 | $521 | $599 |
| Services | do. | $1,751 | $1,885 | $2,135 |
| Government and government enterprises | do. | $2,221 | $2,407 | $2,577 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 7,667 | 14,805 | 18,419 |
| Value of nonresidential construction | millions | $436.4 | $362.2 | $486.8 |
| Value of State road contract awards | do. | $85.0 | $179.0 | $187.2 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 599 | 793 | 974 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $616.1 | $656.6 | $524.2 |
| Value per capita | | $392 | $406 | $317 |

pPreliminary. rRevised. NA Not available.

[1] Bureau of Labor Statistics totals may not add owing to inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

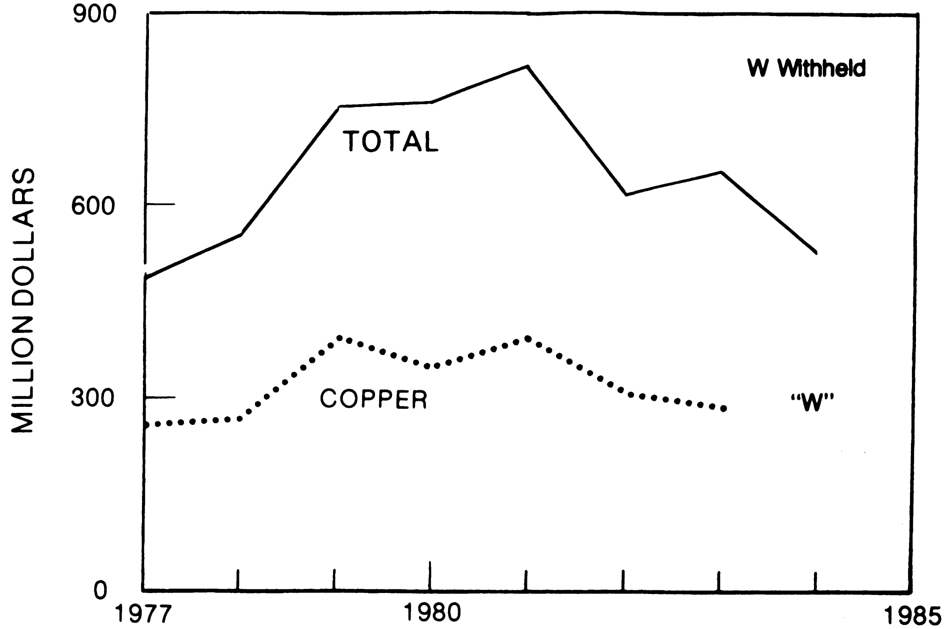

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Utah.

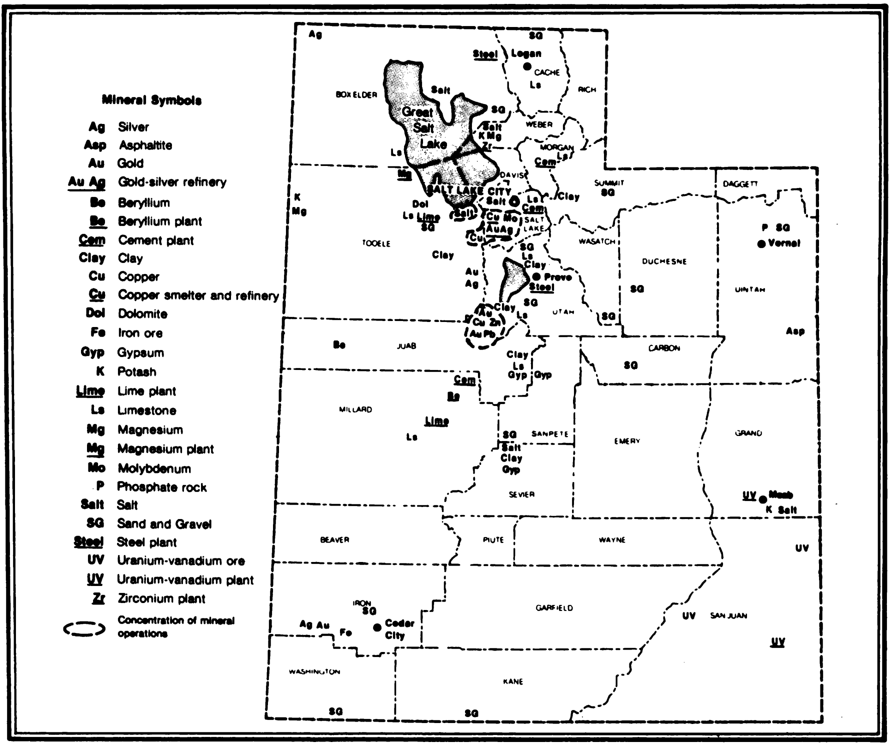

Figure 2.—Principal mineral producing localities in Utah.

**Trends and Developments.**—Mining in the State continued to suffer a series of setbacks. Copper production plummeted as Kennecott reduced output by two-thirds at its Utah Copper Div. when financial losses were exacerbated by the refusal of union representatives to renegotiate mid-1983 labor agreements with the company. Utah's copper industry contended with the lowest copper prices, in real terms, since the Great Depression, sluggish markets, large inventories, and increased competition from imports. Gold, molybdenum, and silver, important byproducts of copper production, also declined as copper mining was cut back and as prices for the precious metal were sharply reduced. Pig iron production increased; however, ores were shipped in from out of State and the depressed steel industry in the State competed with Japanese imports on the west coast, the industry's principal western marketplace for steel. Vanadium output declined sharply as consumption of ferrovanadium by domestic steel producers remained depressed and as continuing low prices for its coproduct uranium resulted in the shutdown of Utah's uranium operations.

In the nonmetals group, production declined even though output of most construction materials rose. Leading commodities, in descending order of value, included cement, construction sand and gravel, salt, potassium salts, phosphate rock, lime, crushed stone, gilsonite, sulfuric acid, gypsum, clays, and sodium sulfate. Declines were noted in all commodities except for the increased output of cement, clays, construction sand and gravel, and crushed stone, which was attributed to significant increases in residential construction and a near record rise in nonresidential construction. Other construction fell 87% in 1984 with the completion of certain powerplants, bridges, and highways, some of which were damaged by flooding in the Great Salt Lake area.[2]

The wet-weather cycle that began in 1982 continued during 1984, causing a rise in the level of Great Salt Lake to a peak of 4,209.6

feet and severely impacting industries on its shores. Magnesium, potash, and salt production were affected when the lake waters diluted their brines and damaged solar evaporation ponds; also, the zirconium industry lost waste water disposal areas to an invasion by Great Salt Lake waters. Potassium salts production declined significantly when most of Great Salt Lake Minerals & Chemicals Corp.'s solar ponds on Great Salt Lake were flooded. The company was the Nation's largest producer of sulfate of potash.

In a growing awareness of the importance of the lake to the State as well as to industries on its shores, the Utah Geological and Mineral Survey published two papers describing the sampling of brines and fluctuations of the levels of Great Salt Lake.[3]

Reduced activity was noted in coal, oil and gas, and uranium mining in Carbon, Emery, Grand, and San Juan Counties. In Emery County, a major disaster occurred in December when a fire at the Wilberg coal mine, operated by the Emery Mining Co. for the Utah Power & Light Co., claimed 25 lives. The mine was closed, causing many more layoffs.

**Legislation and Government Programs.**—The Governor signed four bills related to mining that were passed by the 1984 budget session of the 45th Legislature, meeting from January 9 to January 28. S.B. 22 exempted modernization, expansion, or new construction in the mining industry from the sales or use tax for 5 years beginning July 1, 1984; the exemption applied to purchases over $500,000 per year for materials, equipment, or services for any mine, mill, reduction works, smelter, refinery (except oil and gas), synthetic fuel-processing and upgrading plant, rolling mill, coal washing plant, or melting facility. H.B. 30 authorized the Division of State Lands to breach the Southern Pacific Railroad causeway and to construct a trestle to lower the water level of the Great Salt Lake south arm. S.B. 112 increased the occupation tax on oil and gas from 2% to 4% (except wells producing less than 20 barrels per day). H.B. 180 raised the corporate franchise tax (based on income) from 4% to 5%. The 3d special session of the 1984 45th Legislature passed S.B. 1, one provision of which provided an appropriation of $600,000 to the Water Resources Division to complete studies on Great Salt Lake management.

The U.S. Department of Energy and the Utah Department of Health awarded Argee Corp., Denver, CO, a $37.9 million contract to remove 2.9 million tons of uranium-vanadium tailings from the old Vitro Chemical Co. site in south Salt Lake City. The tailings will be moved by 100-ton, 100-car trains 85 miles to a remote area at Clive, Tooele County, after the disposal sites have been prepared. A $1.7 million plant will be built at Vitro to clean ground water and an aggregate plant at Clive to produce material to cover the tailings.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### METALS

**Beryllium.**—Beryllium ore production declined in quantity and value during 1984. Brush Wellman Inc. continued as the principal producer of beryllium in the United States and the only company recovering the beryllium product from bertrandite ore. According to its 1984 annual report, Brush Wellman produced 402,000 pounds of beryllium in 1984, compared with 458,000 pounds in 1983. The average market price of beryllium dropped from $59 in 1983 to $54 per pound in 1984. The company estimated proven bertrandite ore reserves at 5.4 million short tons averaging 0.22% beryllium, as of December 31, 1984.

Bertrandite ores were surface mined by Brush Wellman and then trucked to its mill near Lyndall, north of Delta, Millard County, for processing into beryllium hydroxide. The company also purchased beryl ores, primarily from foreign sources, for treatment in a separate circuit, reactivated after an equipment failure in 1983. The beryllium hydroxide product was shipped to the company's Elmore, OH, plant for conversion to beryllium alloys, beryllia ceramic, and metallic beryllium.

**Copper.**—Copper production in the State continued to decline for the third straight year and, in 1984, dropped more than one-third in value as the average copper cathode price plunged from $0.7653 in 1983 to $0.6676 in 1984.

Utah's principal copper producer was Kennecott, a subsidiary of Kennecott Corp. acquired in 1981 by Standard Oil Co. of Ohio (Sohio). Sohio was 50% owned by British Petroleum Co. Ltd. The Utah Copper Div. at

Bingham Canyon, 25 miles southwest of Salt Lake City, included one of the world's largest open pit copper mines and a precipitate plant. Sixteen miles to the north were the company's Bonneville crushing and grinding concentrator and the Magna and Arthur flotation concentrators capable of treating 108,000 tons of ore per day; a smelter with an annual production capacity of 210,000 tons of copper anode; and a refinery with an annual capacity of 195,000 tons of copper cathode. The North Ore Shoot underground mine at Bingham was still being developed.

The Sohio 1984 10K Annual Report to the Securities and Exchange Commission showed the Utah Copper Div. mined and processed 21,965,000 short tons of ore yielding 139,891 tons of copper, compared with 33,310,000 tons of ore yielding 200,842 tons of copper in 1983. The average grade of ore mined increased from 0.626% copper in 1983 to 0.663% in 1984. In descending order of quantity, byproduct gold, molybdenum, silver, and selenium, also were recovered. Kennecott's total operating losses rose from $91 million in 1983 to $160 million in 1984, owing principally to a world oversupply of copper, deteriorating copper prices, and mine curtailment costs.

Kennecott reported that although its Utah property was competitive on a world scale, both in size and quality of reserves, the operation was not profitable because of low copper prices and antiquated mining, transportation, and concentrating facilities. The Magna mill was opened in 1907, the Arthur mill in 1908, and the Bonneville crushing and grinding plant in 1966. Modernization of the facilities was still under study during 1984. Proposed changes included in-pit crushing of ore, use of a conveyor system to carry ore to a concentrator to be built north of Copperton, and pipelining the concentrates to the Garfield smelter and tailings to the Magna ponds.

In December, the Salt Lake Planning Commission approved zoning changes allowing the construction of the concentrator and conveyor systems that were scheduled to begin in the third quarter of 1985 and to be completed in 1988, pending approval of Sohio's board of directors.

Citing continued losses and the failure of its unions to renegotiate its 1983 labor agreement, Kennecott slashed Utah Copper Div. production by two-thirds, beginning July 1. About 1,795 workers were gradually laid off during the remainder of the year. The total work force at Kennecott headquarters and Utah Copper Div. dropped from a peak of 8,000 workers in 1972, to 7,400 in 1981, to 4,400 in 1983, to 2,200 at yearend 1984. The copper worker's earnings averaged more than $22 per hour in wages and benefits in 1984, of which $13.38 was an average hourly wage, compared with an all-U.S.-industries average of $8.96 per hour.

A 5-year study, funded by Kennecott in 1983, continued to investigate ground water contamination from the Bingham Canyon operation. A company report to the State Water Pollution Control Committee, Safe Drinking Water Committee, and Solid and Hazardous Wastes Committee indicated no contamination of drinking water had been found, although shallow ground water in localized areas around evaporation ponds in South Jordan, the waste dump leaching system, and the Bingham Canyon Reservoir had been affected. In the 200-square-mile area studied in 1984, 4 wells were drilled to monitor the quality of deep ground water, and 64 private wells, 48 wells on Kennecott property, and 29 surface water sampling sites were checked. After contamination occurred in the Dry Fork area 5 miles north of the open pit, the company spent more than $10 million to build concrete-lined and clay-lined structures and evaporation ponds to capture expected heavy runoff water.

Kennecott and Anaconda Minerals Co. signed a Letter of Understanding for the cooperative operation of the mining and concentrating properties and facilities of the Bingham Canyon Mine and of Anaconda's adjoining Carr Fork Mine in early November. If the agreement is completed in 1985, Kennecott, the operator, would receive 96% of the production. The Carr Fork operation was shut down in October 1982 because of low copper prices and mining problems.

Sunshine Mining Co. shipped a copper-silver ore from the Trixie Mine, East Tintic mining district, Utah County, to Kennecott's Garfield smelter for use as a flux. Kennecott mined a small amount of copper at its precious- and base-metals Iron Blossom Mine, Tintic mining district, Juab County.

**Table 4.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county**

| County | Lode mines producing[1] | Material sold or treated[2] (metric tons) | Gold |  | Silver |  | Copper |  | Lead |  | Zinc |  | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Troy ounces | Value | Troy ounces | Value | Metric tons | Value | Metric tons | Value | Metric tons | Value |  |
| 1982, total | 6 | 33,764,573 | 174,940 | $65,761,695 | 4,342,333 | $34,521,547 | 189,090 | $303,483,112 | W | W | -- | -- | W |
| 1983, total | 6 | 31,152,258 | 238,459 | 101,106,616 | 4,566,610 | 52,242,019 | 169,751 | 286,403,329 | -- | -- | -- | -- | $439,751,964 |
| 1984: |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Box Elder | 1 | W | W | W | W | W | -- | -- | -- | -- | -- | -- | W |
| Iron | 1 | W | W | W | W | W | -- | -- | -- | -- | -- | -- | W |
| Juab | 1 | W | W | W | W | W | W | W | W | W | W | W | W |
| Salt Lake | 1 | W | W | W | W | W | W | W | -- | -- | -- | -- | W |
| Tooele | 1 | 1,029,453 | 79,105 | 28,529,851 | 2,594 | 21,117 | -- | -- | -- | -- | -- | -- | 28,550,968 |
| Utah | 1 | W | W | W | W | W | W | W | -- | -- | -- | -- | W |
| Total | 6 | W | W | W | W | W | W | W | W | W | W | W | W |

W Withheld to avoid disclosing company proprietary data.

[1] Operations at which metals were recovered only from tailings or precipitates are not counted as producing mines.

[2] Does not include gravel washed.

**Gallium and Germanium.**—St. George Mining Co., a subsidiary of Musto Explorations Ltd., Vancouver, Canada, continued to develop the old Apex copper-silver-zinc property for gallium and germanium. Located west of St. George in the Tutsagubet mining district near the southern end of the Beaver Dam Mountains, the property consisted of 22 patented and 9 unpatented mineral claims and 2 leased claims. Mineralization was associated with the Apex vein and is in the form of an irregular chimney of leached, residual iron oxide in dolomite and limestone. Musto planned to invest more than $12 million to complete the development of the mine and to construct a processing plant.[4] By yearend, the warehouse, laboratory, and shop buildings had been completed and construction on the processing plant and tailings ponds commenced. Hazen Research Inc., Golden, CO, spent 2 years developing the new process in which a hot acid leach and cementation was to be used to recover copper and silver; solvent extraction would separate gallium, iron, and zinc; and germanium would be chemically separated from the raffinate. Stockpiled ore was expected to provide feed for about 18 months of production.

Gallium and germanium were used in electronic applications, and germanium was used for infrared optics, fiber optics, semiconductors, and detectors.

**Gold.**—Gold production declined in quantity and value as Kennecott's Utah Copper Div. cut back its Bingham Canyon operation and, consequently, its yield of gold recovered as a byproduct. The drop in gold production value was partly attributed to the plunge in the price of gold from an average of $423.823 per troy ounce in 1983 to $360.656 in 1984. Additional gold producers, in descending order of output, included the Mercur gold mine of Getty Mining Co., a wholly owned subsidiary of Texaco Inc.; the Escalante Mine of Hecla Mining Co.; and the Iron Blossom Mine of Kennecott.

Getty Mining completed its first full year of production at its Mercur gold project, Camp Floyd (Mercur) mining district, Tooele County, 65 miles south of Salt Lake City and 30 miles southeast of Tooele. The mine continued as the State's second largest gold producer.

In February, Texaco took over Getty Oil Co., the parent company of Getty Mining, and by yearend, was discussing selling the company's Utah gold and coal properties.

According to the Gold Standard Co. 1984 annual report, 30,000 troy ounces of gold were recovered in 1983 from the Mercur ores and 80,000 troy ounces in 1984. Gold Standard, owner of the mine's original 4,500 acres, was to receive 15% of the net profits after Getty Mining recovered its own investment. A brief history and engineering design of the Mercur gold project ore processing facility were described in the literature.[5]

**Iron Ore and Steel.**—Utah iron ore production ceased in 1982. The last stockpiled ore in the Iron Springs mining district near Cedar City was shipped in 1983 by United States Steel Corp. (USS) to its Geneva Works near Provo. In 1984, pig iron shipments increased nearly 60% in quantity and value, and iron and steel slag sold and used increased 122% in quantity and more than 64% in value.

With the permanent closing of its Atlantic City, WY, iron ore mine in October 1983, USS supplied its Geneva plant mainly with taconite iron ore pellets from its Minnesota operations. Factors considered in using the higher quality Minnesota ores were mining conditions and lower labor and energy costs. The company also sold its Columbia and Geneva underground coal mines in Carbon County to Kaiser Steel Corp. and continued obtaining coking coal for the steel plant from its captive Somerset Mine near Paonia, CO. At the Geneva Works, the number of open-hearth furnaces in operation was reduced from five to three and layoffs totaled nearly 400 workers, bringing total employment down from 5,000 in 1981 to 2,400 by yearend 1984. Utah County union membership dropped from a peak of 3,800 workers in 1981 to 1,800 in 1984. A privately published study analyzed the forces and issues behind the crisis of the domestic basic steel industry and the implications of national problems for the Geneva Works.[6]

Nucor Steel Co., a division of Nucor Corp., operated its 400,000-ton-per-year steel minimill at Plymouth, Box Elder County. In April, flat demand and competition with other domestic mills and foreign imports forced the company to cut back from a 5- to 4-day week, and mills were reduced from 15 turns per week to 12 turns; no workers were laid off. Products manufactured included reinforcing bars, channels, angles, rounds, flats, and coiled rounds. Nucor's Vulcraft Div. at Brigham City used steel products from the Plymouth operation for the manufacture of joists and joist girders. At the Nucor Grinding Ball Div. near Brigham City, depressed conditions of the mining industry slowed production of steel grinding balls.

**Magnesium.**—Magnesium metal production increased in amount and value, owing in part to a rise in demand for the metal and a small increase in price.

AMAX Magnesium Corp., a subsidiary of AMAX Inc., operated the Nation's second largest magnesium plant on the south arm of Great Salt Lake at Rowley, Tooele County. Magnesium was recovered from lake brines concentrated in 40,000 acres of solar evaporation ponds, processed into magnesium chloride, and electrolytically separated into magnesium metal and chlorine. Heavy precipitation in 1983 diluted lake brines and necessitated a continuing $15 to $20 million project to raise dikes protecting the ponds; in 1984, the plant was altered to process brine with 5.8% magnesium instead of 7.2% magnesium. To augment its own supply of brine, AMAX purchased 300,000 short tons of magnesium chloride from the Kaiser Aluminum & Chemical Corp. plant at Wendover in exchange for 9,000 tons of magnesium metal from AMAX. AMAX also experimented with increasing evaporation by using a triphenyl methane (Neptune Blue) dye to absorb sunlight and raise the water's surface heat, thereby accelerating the evaporation rate. According to the AMAX 1984 10K Annual Report, the Utah facility was operated at a production rate of 35,000 tons per year and made a small profit for the first time in the company's 12-year history.

**Molybdenum.**—The Utah Copper Div., the only molybdenum producer in the State, continued to ship molybdenum concentrate recovered as a byproduct of copper production. As the company's copper output was cut back in mid-1984, the quantity of molybdenum concentrate recovered declined 5.38%. With drawdown on stockpiles, total molybdenum concentrate shipments increased less than 2% in quantity and value. Although exports dropped about 12%, domestic shipments increased dramatically, and by yearend, molybdenum concentrate stocks had been reduced 28%. The U.S. Bureau of Mines estimated the average producers' price dropped from $3.65 per pound in 1983 to $3.50 per pound in 1984.

**Silver.**—Silver output declined in quantity and more than one-third in value as the average price of the metal slipped from $11.44 per troy ounce in 1983 to $8.14 in

1984. The principal silver producer in the State was Hecla's Escalante Mine, Iron County, followed by Kennecott's Bingham Canyon Mine, Salt Lake County; Sunshine's Trixie Mine, Utah County; United Silver Mines Inc.'s Vipont Mine, Box Elder County; Getty Mining's Mercur gold project, Tooele County; and Kennecott's Iron Blossom Mine, Juab County.

Hecla acquired the Escalante Mine in a merger agreement completed with Ranchers Exploration and Development Corp. on July 26, 1984. Since 1975, Ranchers had leased and developed the Escalante Silver Mines Co. Inc. properties 42 miles west of Cedar City, Iron County, and on November 30, 1983, exchanged 345,884 net shares of Escalante Silver Mines. Escalante owned the production royalty, a 10% net profits interest, and the reversionary rights in the mill and mine properties, then operated by Ranchers. After the death of its chief executive officer, Ranchers became the object of complex merger manuevers by First Mississippi Corp., Sunshine, and Hecla, with Hecla emerging as the winner.

While operating the Escalante, Ranchers applied a blasthole open stoping mining system called "end slicing," which the company developed from the vertical crater-retreat mining method initially used at the mine. Mine production was normally 1,000 to 1,200 short tons of ore per day and 350 short tons of waste per day. The Merrill-Crowe precipitation process was used at the 750-ton-per-day mill to recover the silver and a refinery in the mill applied an acid leach to remove the base metals before smelting. Metallurgical recovery at the mill was about 81% of the silver in the ore, with estimated direct milling costs of $1.53 per fine ounce during fiscal year 1983-84.[7]

According to the Hecla 1984 annual report, the Escalante Unit recovered 2,235,781 troy ounces of silver in 1984, compared with 2,247,479 troy ounces in 1983. As of December 31, 1984, reserves were estimated at 2,621,400 tons of ore with 9.4 ounces of silver per ton, compared with 1,582,000 tons with 10.4 ounces per ton in 1983. Exploration during the year indicated a southerly extension of a vein that may add several years to the life of the mine.

The Sunshine 1984 annual report showed the Trixie Mine, East Tintic mining district, Utah County, shipped 21,545 tons of flux ore containing 114,938 ounces of silver, 3,357 ounces of gold, and 438,393 pounds of copper to the Kennecott Garfield smelter in 1984.

In 1984, exploration at the mine totaled 3,460 feet of drifting, 414 feet of raising, and 5,883 feet of long-hole drilling. As of December 31, 1984, reserves were estimated to be 64,540 tons of ore containing 470,588 ounces of silver, 7,187 ounces of gold, and 1.8 million pounds of copper.

At the Burgin Mine, also in the East Tintic area, the Apex No. 2 shaft was completed to the 1,300-foot level in late 1984, and an access drive totaling more than 1,965 feet of drifting was connected with the old Burgin workings when work was suspended pending further evaluation of the project. Working temperatures at one area of the mine were decreased from 130° F to 85° F by installing a refrigeration unit. Resumption of normal metal prices, more favorable metal markets, and favorable findings on the detailed feasibility studies were deemed necessary to bring the Burgin Mine into production again. Reserve estimates increased to 1.9 million tons of ore containing 33.8 million ounces of silver, 65,600 ounces of gold, 288,700 tons of lead, and 109,100 tons of zinc.

The Tintic mining district, which ranked first in Utah's total silver production and second in gold, was described in the literature.[8]

**Vanadium.**—Vanadium production continued to fall, plunging 82% in tonnage and 87% in value, as the prices of its coproduct, uranium, fell from January's $22 per pound of $U_3O_8$ to $15.25 per pound at yearend, and producers shut down or cut back operations. During part of the year, vanadium was recovered from the uranium-vanadium ores of the Colorado Plateau and shipped to the Atlas Corp. mill near Moab, Grand County, or to the Union Carbide Corp. mill at Uravan, CO.

In February, the Atlas Minerals Div. of Atlas Corp. began to idle its properties, including its last three operating mines—Pandora, Velvet, and Rim Columbus—in San Juan County and its Moab uranium-vanadium mill in Grand County. Before completing the shutdown in mid-May, the company processed a large stockpile of ore and drew down its inventory of chemical milling agents. About 175 workers were laid off and 30 retained to maintain the facilities on a standby basis pending an improvement in the uranium market. According to the company, in its fiscal year ending June 30, 1984, Atlas Minerals sold 308,000 pounds of $U_3O_8$ in concentrate and 2,783,000 pounds of vanadium pentoxide recovered from stockpiled ore in 1984, compared with 1,386,000 pounds of $U_3O_8$ in concentrate and 1,405,000 pounds of vanadium pentoxide in 1983 from ores mined in Colorado and Utah. The corporation reported a net loss of $3.89 million in its fiscal year 1984, compared with a $19.4 million profit in 1983.

In anticipation of eventually resuming operations, Atlas continued to seek feed for its Moab plant and acquired additional ore reserves in properties contiguous to its Green River area mines. Feasibility studies were also conducted on the Farley (formerly called Bullfrog) uranium-vanadium deposit, 10 miles north of Ticaboo, Garfield County.

Following a preliminary agreement signed in February 1983, effective January 11, 1984, Union Carbide, Danbury, CT, acquired a 70% interest in Energy Fuels Nuclear Inc.'s White Mesa uranium-vanadium mill near Blanding. Built in 1980, the facility had been idle since January 1983 because of the weak demand for uranium. Umetco Minerals Corp., a newly formed subsidiary of Union Carbide, became the operator of the 2,000-ton-per-day mill after receiving the approval of State and Federal agencies.

South of La Sal, San Juan County, the Rio Algom unit of Rio Algom Ltd., Toronto, Canada, operated the last surviving uranium mill in the State 5 days per week at below its normal capacity of 750 tons per day. About 150 people were employed at the facility. Plans to add an acid circuit to the original alkaline circuit for more flexibility in treating different types of ore were placed on hold; vanadium was never recovered at this mill.

The Hecla and Union Carbide Lisbon Valley uranium-vanadium mine near Moab remained on a standby basis.

**Zinc.**—A small amount of zinc was mined at Kennecott's Iron Blossom Mine, Juab County.

**Zirconium.**—Western Zirconium Inc. continued to produce primary zirconium sponge and coproduct hafnium sponge and converted the zirconium sponge to ingot. The product was produced from zircon ores imported from Australia at a plant in the Southern Pacific Industrial Park, south of Ogden, Weber County.

The company requested permission from the Utah Water Pollution Control Committee to build a $1 million waste water treatment plant to pump the treated water into Great Salt Lake. The rising lake had invaded some 80 acres in existing ponds where waste water had been stored.

## NONMETALS

**Asphalt (Native) and Other Bitumens.**—Gilsonite production rose about 53% in quantity but declined nearly 27% in value. American Gilsonite Co., a subsidiary of Chevron Corp. (formerly Standard Oil Co. of California) and Hydrocarbon Mining Inc., a subsidiary of Western Strategic Minerals Inc., mined the hydrocarbon from veins near Bonanza, Uintah County. The product was marketed for automobile body sealer and radiator paint, inks, oil well-drilling fluids, cement for sand mold in the foundry industry, and other uses.

**Cement.**—Portland cement producers, listed in descending order of 1984 output, included the Southwestern Portland Cement Co., a wholly owned subsidiary of Southdown Inc., Houston, TX, 550,000-short-ton-per-year, dry-process plant at Leamington, Millard County; the Ideal Basic Industries Inc. 350,000-ton-per-year-capacity, wet-process plant at Devils Slide, Morgan County; and the Lone Star Industries Inc. 420,000-ton-per-year, wet-process plant in Salt Lake City.

Finished portland cement output increased 25%; sales increased nearly 20% in quantity and 26% in value as residential building activity increased significantly and nonresidential construction reached a record high. The average price per ton of portland cement rose from $51.22 in 1983 to $53.93 in 1984. A small amount of cement was transported by rail, but, by far, most was trucked in bulk to the consumers.

On April 3, Southwestern Portland Cement entered into an agreement to lease, with an option to purchase, the Martin Marietta Corp. Leamington portland cement plant in Millard County. The 5-year lease provided two additional 3-year renewal periods at the option of Martin Marietta; however, if Southwestern did not exercise the purchase option, a $10 million termination payment would be required. Southwestern also purchased Martin Marietta's Leamington working capital, estimated at $12 million. According to Southdown's 1984 10K Annual Report, the market area of the plant included central and southern Utah, Colorado's western slope, southeastern Nevada, southwestern Wyoming, and northwestern New Mexico.

The Federal Environment Protection Agency included two dumps at one cement company on the Superfund list, making the sites eligible for cleanup money if the problem is not voluntarily solved. High concentrations of heavy metals, including arsenic, chromium, and lead, were cited as being present in kiln dust and bricks.

**Clays.**—Clay and shale output increased in quantity and value; the average unit value increased marginally from $7.13 in 1983 to $7.14 in 1984. The principal common clay and shale producer was Utelite Corp., Summit County, followed by Interpace Corp., Utah County; Interstate Brick Co. at its Five-Mile pit, Tooele County, and Jim Gay pit, Utah County; Martin Marietta at its Hank Allen pit, Juab County; and Redmond Clay and Salt Co. at its Sanpete County pit.

Western Clay Co. mined swelling bentonite at its Redmond pit and fuller's earth at its Aurora pit, both in Sevier County. R. D. Wadley Clay Co. mined fire clay at its Wadley pit, Utah County.

The common clays were used mainly for manufacturing face brick and lightweight aggregate, followed by portland cement, terra cotta, floor and wall ceramics, adhesives, and animal feed. The expanded aggregate was used largely in structural concrete and block. Swelling bentonite was used for animal feed, drilling mud, and waterproof sealant. Fire clay was used for foundry purposes and fuller's earth for mineral oil clarification.

**Graphite (Synthetic).**—Hercules Inc., Aerospace Div., at its Bacchus Works, was the principal producer of synthetic graphite, manufacturing the commodity for use in place of metals in aerospace equipment, tennis rackets, leg braces, and for other purposes where weight was important. In 1984, the company, with more than 5,325 employees, became the second largest private industrial employer in the State. Synthetic graphite output increased about 43% in quantity and value.

**Gypsum.**—Although production of gypsum declined, output of the calcined product used for wallboard increased more than 11% in quantity and nearly 21% in value. Georgia-Pacific Corp. and United States Gypsum Co. continued as the principal producers of crude and calcined gypsum. Gypsum was mined 9 and 7 miles, respectively, northeast of the companies' crushing and processing facilities at Sigurd, Sevier County. Crude gypsum was also mined by Thomas J. Peck & Sons Inc. near Nephi, Juab County.

**Lime.**—Lime production decreased in quantity and value as the steel and copper industries cut back production. Leading quicklime producers included Continental Lime Inc., a subsidiary of Steel Bros. Canada Ltd., 35 miles south of Delta and 6 miles west of the plant at the base of the Cricket Mountains, Millard County; Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp., 35 miles northwest of Grantsville, Tooele County; Genstar Lime Co., a subsidiary of Genstar Corp., Toronto, Canada, at Grantsville, Tooele County; and Kennecott Utah Copper Div. Genstar was the sole producer of hydrated lime.

**Magnesium Compounds.**—Although magnesium compounds' sales increased nearly 17% in quantity, their value declined about 4%. Great Salt Lake Minerals, a division of Gulf Resources & Chemicals Corp., with an annual capacity of 100,000 short tons of magnesium oxide equivalent, obtained magnesium chloride and other products from the brines of Great Salt Lake, west of Ogden, Weber County. Magnesium chloride in bitterns was recovered as the final product from the solar evaporation of lake brines. Kaiser Aluminum & Chemical, with an annual capacity of 50,000 tons of MgO equivalent, recovered magnesium compounds using solar evaporation from the brines of Great Salt Lake at its Bonneville plant near Wendover, Tooele County. In a reciprocal purchase of products, Kaiser sold 300,000 tons of magnesium chloride brine to AMAX Magnesium Corp. at Rowley, and Kaiser, in turn, bought 9,000 tons of magnesium metal from AMAX. Unusually wet weather had diluted brines used by AMAX in magnesium metal production.

**Perlite (Expanded).**—Perlite was shipped in from out of State for expansion at the Pax Co. plant in Salt Lake County and at the Georgia-Pacific plant at Sigurd. Production of the treated product declined 9% in quantity and over 13% in value.

**Phosphate Rock.**—Chevron Resources Co. continued as the only phosphate rock producer in the State and mined phosphate rock from the Upper Permian Age Park City Formation 12 miles north of Vernal, Uintah County. Ores were crushed at the minesite and transported by a 10-inch slurry pipeline to the mill for further grinding and classification, followed by flotation. About 18 trucks per day were used to deliver concentrates to the Phoston rail terminal, north of Heber, Wasatch County, for shipment to Canadian fertilizer plants.

As part of a $250 million phosphate fertilizer complex to be built in Wyoming and Utah, Chevron began a $70 million expansion project at its mine and beneficiation plant near Vernal. New autogenous and conventional grinding mills and two pumping stations were installed at Vernal. Extensive reclamation work, including recontouring the area, repositioning topsoil, and seeding was continued on some currently and previously mined land in the Brush Creek area. A 10-inch-diameter phosphate slurry pipeline was to be laid 95 miles from the beneficiation plant to a new 400,000-ton-per-year ammonium phosphate fertilizer plant near Rock Springs, WY. Construction on the Wyoming plant began in mid-1984 and was scheduled for completion in late 1986. Up to 1.8 million tons per year of phosphate concentrates will be slurried and pumped over a 7,200-foot pass in the Uintah Mountains. Water for the slurry will come from reclaimed waste water at the Vernal operation. The Phoston railhead operation will be discontinued as will shipments of six cars per day of phosphate concentrate to Salt Lake City.

Utah phosphate rock production declined about 5% in quantity and value in 1984, while output of the combined Western States, Idaho, Montana, and Utah, producing more than 10% of the Nation's phosphate, dropped less. According to Chevron, production of about 550,000 short tons of concentrates per year in 1984 was expected to increase to 1.3 million tons by 1986. The quantity of ore mined per year will be increased from 1.5 to 3.5 million tons.[9]

About 130 persons were employed at the Brush Creek area operation in 1984. An average of 400 workers were to be employed during the construction period.

**Potash.**—Nationally, Utah ranked second in potash production, behind New Mexico and followed by California. In contrast to increased output and sales in the other two States, Utah's production of potassium salts decreased 32%. Total sales declined nearly 13% in quantity and 30% in value of $K_2O$ equivalent. Stocks dropped 66% by the end of the reporting period. The decrease in output and the drop in stocks of potassium salts was due to heavy precipitation and consequent dilution of brines and the flooding of evaporation ponds in the Great Salt Lake area.

Two companies, Texasgulf Chemicals Co. of Texasgulf Inc. and Kaiser Chemicals of Kaiser Aluminum & Chemical, recovered potassium salts in the State. Texasgulf, a subsidiary of Société Nationale Elf Aquitaine (a 67% French Government-controlled oil company), recovered potassium salts at its Cane Creek operation near Moab, Grand County. Pennsylvanian Age evaporites were solution mined using geothermal heat to dissolve the potash at a depth of 2,789 feet. Brines were pumped to the surface for evaporation on 400 acres of solar ponds and salts harvested and processed by flotation to recover potassium salts and byproduct salt.

According to the Elf Aquitaine Inc. 1984 annual report, potash production was 142,000 tons in 1984, compared with 157,000 tons in 1983. In the Cane Creek area, the decrease in output was attributed to deferring the harvest of some 1984 potash from the solar ponds until 1985.

The Kaiser solar evaporation operation near Wendover covered about 87,816 acres from which, in normal times, natural brines were collected in 140 miles of ditches on the Bonneville Salt Flats of Great Salt Lake. The brines were concentrated in a primary 8,000-acre evaporation pond. Potassium salts were processed through a flotation concentrator to separate the halite (sodium chloride) and sylvite (potassium chloride). The facilities, which were closed in the fall of 1983 owing to excessive rain and flooding in the area, remained idle during most of 1984. Customers were supplied from inventories throughout the year. During the summer of 1984, gathering canals dried out, allowing the company to harvest some crude salts for potash production by year-end.

Great Salt Lake Minerals normally recovered potassium sulfate (also called sulfate of potash), salt, sodium sulfate, and magnesium chloride from the concentrated brines of Great Salt Lake. The brines were pumped from the north arm of the lake to 19,500 acres of solar evaporation ponds on Bear Lake Bay west of Ogden at Little Mountain, Weber County. The processes included selective crystallization and deposition of salts. The products either were sold in a crude state or were processed into finished commodities at the plant.

On May 5, nearly 85% of its solar evaporation ponds were flooded when the outer dike of the system was breached, resulting in severe damage to dikes, pond floors, bridges, pump stations, and other structures. Brine solutions were diluted, rendering them unsuitable for the production of sulfate of potash. Great Salt Lake Minerals received a $10 million advance from a business interruption insurance claim and continued to repair dikes to protect the pond system. In 1983, the company spent $8.1 million and, in early 1984, $8.3 million to raise the dikes. Several years will be required to resume full production of potassium sulfate. Before the flooding of its ponds, the firm was the largest producer of potassium sulfate, a specialty fertilizer, in the United States.

According to the Gulf Resources & Chemical Corp. 1984 10K Annual Report, potassium sulfate production declined from a high of 203,000 short tons in 1981, to 150,000 in 1983, to zero in 1984, because of the wet weather cycle, which began in 1982 and continued during 1984, raising Great Salt Lake to near record-high levels. In August, because of the flooding, 50 employees were laid off, reducing the work force to 190.

On November 1, Buttes Resources Co., a subsidiary of Buttes Gas & Oil Co., and the Bureau of Land Management (BLM) signed a potash mining lease on approximately 12 square miles of Federal land near the Grand County airport, 12 miles north of Moab. Application to BLM for prospecting permits started in 1972, initial exploration in the area began in 1978, and several million dollars had been spent on the project by 1984. Full-scale development of a solution mine was expected within a few years, with production of 1 million tons of potash annually and employment for 350 workers.

**Salt.**—Solar salt was produced in Grand County by Texasgulf; in Salt Lake County by Morton Salt Co., a division of Morton-Thiokol Inc.; in Tooele County by American Salt Co., a subsidiary of General Host Corp.; and in Weber County by Great Salt Lake Minerals. In Grand County, Moab Brine Co., a subsidiary of La Sal Oil Co., recovered salt from brine; and in Sevier County, Redmond Clay and Salt Co. obtained rock salt at the American Orsa open pit salt mine at Redmond. Salt sales rose more than 33% in quantity and nearly 24% in value because of the severe winter, resulting in an increased demand for salt to deice the roads.

Redmond Clay and Salt had one of the largest open pit salt mines in the West and produced rock salt, used principally for livestock purposes. A major portion of the product was shipped to the States adjacent to Utah.

General Host placed its American Salt on the market in the spring and, after Diamond Crystal Salt Co. turned down a Letter of Intent to purchase, the company was still for sale at yearend. American Salt's Grantsville facility consisted of approximately 15,000 acres and 4,800 acres in leases; concentrating and crystallizing ponds for solar evaporation; a washing station and bulk storage area; and a refining mill for sizing, mixing, and packaging products. During 1983 and 1984, the company raised its perimeter dike to protect its pond system from the rising waters of Great Salt Lake, thereby maintaining the company's salt production level. Other companies in the area were severely impacted by flooding.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel production in Utah increased during the year. In 1984, 63 producers obtained construction sand from 99 operations in 24 counties. The major producing counties were Salt Lake, with about 33% of the State total; Davis, with about 11%; and Utah, with about 9%. Ten leading construction sand and gravel producers, each of whom produced more than 500,000 short tons, provided 57% of the production in the State. The following, listed in descending order of output, were the largest sand and gravel producing companies: Monroc Inc., Jack B. Parson Construction Co., Gibbons and Reed Co., Peter Kiewit and Sons Co., MAC/CEI Joint Venture Co., and Geneva Rock Products Co., collectively accounting for more than 40% of the total. The major use of sand and gravel in the State was in road base and coverings and stabilization, followed by concrete aggregate, asphaltic concrete, and fill. All transport of sand and gravel was by truck. The average value of sand and gravel sold during the year was $2.27.

*Industrial.*—Industrial sand is surveyed every year and in 1984 was produced by one company at one site in Salt Lake County. Total output was very small and was used entirely for molding and core and sandblasting.

**Table 5.—Utah: Construction sand and gravel sold or used by producers in 1984, by use**

| Use | Quantity (thousand short tons | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 2,881 | $7,359 | $2.55 |
| Plaster and gunite sands | 70 | 177 | 2.54 |
| Concrete products | 27 | 80 | 2.96 |
| Asphaltic concrete | 1,546 | 4,976 | 3.22 |
| Road base and coverings[1] | 2,888 | 6,809 | 2.36 |
| Fill | 1,431 | 1,759 | 1.23 |
| Snow and ice control | 37 | 58 | 1.57 |
| Other[2] | 6,337 | 13,289 | 2.10 |
| Total or average | 15,217 | 34,507 | 2.27 |

[1] Includes road and other stabilization (cement).
[2] Includes other unspecified uses.

**Sodium Sulfate.**—Great Salt Lake Minerals continued to recover byproduct sodium sulfate from the brines of Great Salt Lake at its operation west of Ogden despite the effects of the flooded ponds. Of the three States producing the product—California, Texas, and Utah—Utah ranked third. Output of the commodity remained the same as that of 1983, however, it rose slightly in value.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

The quantity and value of crushed stone production increased again as railroads and industries on the shores of Great Salt Lake continued to raise and strengthen rail lines across the lake and to construct dikes protecting magnesium, potash, and salt plants. In one example, at a cost of $48 million over the past 2 years, the Southern Pacific Transportation Co. raised about 40 miles of rail line as much as 7 feet to safeguard its causeway across the north arm of Great Salt Lake.

**Sulfur (Recovered).**—Sulfur recovered from the Chevron Oil Co. refinery in Davis County increased in quantity but declined in value.

**Sulfuric Acid.**—Utah ranked third among the States in output of byproduct sulfuric acid. Recovered as a byproduct of copper production, the quantity of the commodity produced in the State declined but rose in value. Nationally, sulfuric acid production increased substantially.

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[1] State Mineral Officer, Bureau of Mines, Denver, CO.

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[4] Russell, W. Only U.S. Gallium-Germanium Brine On Line Soon. Intermountain Pay Dirt, No. 63, Dec. 1984, p. 1, 4A, 5A.

[5] Turk, T. W., and S. A. Sass. Engineering Design of the Mercur Gold Project Ore Processing Facility. Min. Eng., v. 36, No. 11, Nov. 1984, pp. 1563-1567.

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[7] Burger, J. R. Ranchers End-Slices Escalante Silver Deposit. Eng. Min. J., v. 184, No. 1, Jan. 1984, pp. 48-53.

[8] James, L. P. The Tintic Mining District. Survey Notes, v. 18, No. 2, Summer 1984, pp. 1, 4-13.

[9] Vernal Express. Phosphate Activity to Escalate. Oct. 17, 1984.

## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Asphalt: | | | |
| American Gilsonite Co., a subsidiary of Chevron Corp. | Suite 1150, Kennecott Bldg.<br>Salt Lake City, UT 84133 | Underground mines and plant | Uintah. |
| Hydrocarbon Mining Inc., a subsidiary of Western Strategic Minerals Inc. | North 9507 Division St.<br>Suite A<br>Spokane, WA 99218 | do | Do. |
| Beryllium: | | | |
| Brush Wellman Inc | 67 West 2950 South<br>Salt Lake City, UT 84115 | Open pit mines and plant | Juab and Millard. |
| Cement: | | | |
| Ideal Basic Industries Inc., Cement Div.[1] | Star Route<br>Morgan, UT 84050 | Quarries and plant | Morgan. |
| Portland Cement Co. of Utah, a division of Lone Star Industries Inc.[1] | 615 West 800 South<br>Box 1469<br>Salt Lake City, UT 84110 | do | Salt Lake. |
| Southwestern Portland Cement Co., a subsidiary of Southdown Inc.[1] [2] | 4885 South 900 East<br>Salt Lake City, UT 84117 | do | Millard. |
| Clays: | | | |
| Interpace Corp., Structural Div. | 736 West Harrisville Rd.<br>Box 447<br>Ogden, UT 84402 | Open pit mines and plant | Utah. |
| Interstate Brick Co., a subsidiary of Mountain Fuel Co. | 9780 South 5200 West<br>West Jordan, UT 84084 | do | Tooele and Utah. |
| Utelite Corp | Box 387<br>Coalville, UT 84017 | Open pit mine and plant | Summit. |
| Western Clay Co.[1] | Box 1067<br>Aurora, UT 84620 | Open pit mines | Sevier. |
| Copper: | | | |
| Kennecott, a subsidiary of Kennecott Corp., Utah Copper Div.[3] | 1129 East 3900 South<br>Box 6500<br>Salt Lake City, UT 84106 | Open pit mine, mills, smelter, refinery. | Salt Lake. |
| Gold: | | | |
| Getty Mining Co., a subsidiary of Texaco Inc. | Box 838<br>Tooele, UT 84074 | Open pit mine, mill, carbon-in-pulp plant. | Tooele. |
| Gypsum: | | | |
| Georgia-Pacific Corp | Box 80<br>Sigurd, UT 84657 | Open pit mine and plant | Sevier. |
| United States Gypsum Co | Box 120<br>Sigurd, UT 84657 | do | Do. |
| Iron and steel: | | | |
| United States Steel Corp.[1] | Geneva Works<br>Box 510<br>Provo, UT 84603 | Steel plant | Iron. |
| Lime: | | | |
| Continental Lime Inc., a subsidiary of Steel Bros. Canada Ltd.[1] | 268 West 400 South<br>Suite 201<br>Salt Lake City, UT 84101 | Quarry and plant | Millard. |
| Genstar Lime Co., a subsidiary of Genstar Corp.[1] | Box 357<br>Grantsville, UT 84029 | Open pit mine and plant | Tooele. |
| Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp.[1] | Box 596<br>Grantsville, UT 84029 | do | Do. |
| Magnesium: | | | |
| AMAX Magnesium Corp., a subsidiary of AMAX Inc. | 238 North 2200 West<br>Salt Lake City, UT 84116 | Solar evaporation plant | Do. |
| Phosphate rock: | | | |
| Chevron Resources Co., a subsidiary of Chevron Corp. | Manila Star Route<br>Vernal, UT 84078 | Open pit mine and plant | Uintah. |
| Potassium salts: | | | |
| Great Salt Lake Minerals & Chemicals Corp., a division of Gulf Resources & Chemicals Corp.[4] | 765 North 10500 West<br>Little Mountain<br>Box 1190<br>Ogden, UT 84402 | Solar evaporation, concentrator, plant. | Weber. |
| Kaiser Aluminum & Chemical Corp., Bonneville Ltd. Div.[5] | Box 580<br>Wendover, UT 84083 | do | Tooele. |
| Texasgulf Inc., a subsidiary of Société Nationale Elf Aquitaine.[6] | Box 1208<br>Moab, UT 84532 | Solution mine, solar evaporation, concentrator, plant. | Grand. |
| Salt: | | | |
| American Salt Co | Box 477<br>Grantsville, UT 84029 | Plant | Tooele. |
| Morton Salt Co., a division of Morton-Thiokol Inc. | A.M.F. Box 22054<br>Salt Lake City, UT 84122 | do | Salt Lake. |

See footnotes at end of table.

Table 6.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Sand and gravel: | | | |
| Construction: | | | |
| Concrete Products Co., a division of Gibbons & Reed Co. | 41 West Central Ave.<br>Box 7356<br>Murray, UT 84107 | Pits and plant | Davis,<br>Salt Lake,<br>Summit,<br>Tooele,<br>Utah,<br>Weber. |
| Peter Kiewit and Sons Co. | 370 West 5900 South<br>Box 7780<br>Murray, UT 84107 | do | Sevier. |
| Monroc Inc | 1730 North Beck St.<br>Box 537<br>Salt Lake City, UT 84110 | do | Salt Lake. |
| Jack B. Parson Construction Co. | Box 3429<br>Ogden, UT 84409 | Pits and plants | Box Elder,<br>Cache,<br>Davis,<br>Morgan. |
| Industrial: | | | |
| Salt Lake Valley Sand & Gravel Co. | 800 North 1550 West<br>Orem, UT 84057 | Pit | Salt Lake. |
| Silver: | | | |
| Hecla Mining Co., Escalante Unit. | Box 308<br>Enterprise, UT 84725 | Underground mine, mill, plant. | Iron. |
| Vanadium: | | | |
| Atlas Minerals Div., Atlas Corp. | Box 1207<br>Moab, UT 84532 | Underground mines and mill | Emery,<br>Grand,<br>San Juan. |
| Energy Fuels Nuclear Inc | Box 787<br>Blanding, UT 84511 | Underground mines, ore-buying station, research laboratory. | Emery,<br>Garfield,<br>San Juan. |
| Umetco Minerals Corp., a subsidiary of Union Carbide Corp. | Box 1029<br>Grand Junction, CO 81501 | Underground mines and mill | Grand and San Juan. |

[1] Also stone.

[2] Also clays

# The Mineral Industry of Vermont

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Office of the State Geologist, Agency of Environmental Conservation, for collecting information on all nonfuel minerals.**

### By L. J. Prosser, Jr.,[1] and Charles A. Ratté[2]

The value of nonfuel mineral production in Vermont was $45.1 million in 1984. During the year, a new stone quarry was opened in Clarendon. Plans for development of an underground talc mine in Chester and a marble quarry in Brandon were near completion. A talc mill in Johnson, shut down in 1983, was purchased and reopened. Sale of the State's leading dimension granite producer in Barre was finalized. An exploration program for copper in Corinth was initiated. A proposal to mine and mill kaolin in Bennington was presented for local and State review prior to permitting. An oil and gas well drilled in Fairfield was abandoned and plugged.

**Table 1.—Nonfuel mineral production in Vermont[1]**

| Mineral | 1983 |  | 1984 |  |
|---|---|---|---|---|
|  | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Sand and gravel (construction) thousand short tons | e3,000 | e$6,200 | 3,802 | $8,071 |
| Stone: |  |  |  |  |
| Crushed do. | 1,339 | 5,579 | e1,800 | e7,000 |
| Dimension do. | r116 | 19,995 | e116 | e20,462 |
| Combined value of talc and other nonmetals | XX | 10,355 | XX | 9,565 |
| Total | XX | 42,129 | XX | 45,098 |

eEstimated. rRevised. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Vermont, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Addison | $473 | W | Stone (crushed). |
| Bennington | 1,749 | W | Stone (dimension). |
| Caledonia | 233 | (2) | |
| Chittenden | 1,599 | W | Stone (crushed). |
| Essex | W | (2) | |
| Franklin | 215 | W | Stone (crushed). |
| Lamoille | W | W | Talc. |
| Orange | 246 | (2) | |
| Orleans | 703 | W | Asbestos, stone (crushed). |
| Rutland | 620 | W | Stone (dimension), stone (crushed). |
| Washington | 295 | W | Do. |
| Windham | W | W | Talc. |
| Windsor | W | W | Talc, stone (dimension), stone (crushed). |
| Undistributed[3] | 9,271 | $35,929 | |
| Sand and gravel (construction) | XX | [e]6,200 | |
| Stone: | | | |
| Crushed | [e]5,300 | XX | |
| Dimension | [r] [e]18,358 | XX | |
| Total | [r]39,062 | 42,129 | |

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1]No production of nonfuel mineral commodities was reported in Grand Isle County.

[2]Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3]Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

## Table 3.—Indicators of Vermont business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 520 | 525 | 530 |
| Total civilian labor force | do. | 267 | 265 | 269 |
| Unemployment | do. | 18 | 18 | 14 |
| Employment (nonagricultural): | | | | |
| Mining total | do. | 0.7 | 0.6 | 0.5 |
| Manufacturing total | do. | 48.6 | 47.6 | 48.7 |
| Primary metal industries[1] | do. | .6 | .7 | NA |
| Stone, clay, and glass products | do. | 2.1 | 2.1 | 2.1 |
| Chemicals and allied products[1] | do. | .7 | .8 | NA |
| Construction | do. | 9.9 | 10.9 | 12.1 |
| Transportation and public utilities | do. | 8.7 | 8.7 | 9.2 |
| Wholesale and retail trade | do. | 43.0 | 44.1 | 46.7 |
| Finance, insurance, real estate | do. | 8.5 | 8.9 | 9.4 |
| Services | do. | 47.5 | 49.3 | 51.6 |
| Government and government enterprises | do. | 36.0 | 36.3 | 36.6 |
| Total | do. | 202.9 | 206.4 | 214.8 |
| Personal income: | | | | |
| Total | millions | $4,950 | $5,247 | $5,723 |
| Per capita | | $9,518 | $9,987 | $10,802 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.0 | 40.0 | 40.6 |
| Total average hourly earnings, production workers | | $7.35 | $7.66 | $8.03 |

See footnotes at end of table.

## Table 3.—Indicators of Vermont business activity —Continued

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Earnings by industry: | | | | |
| Farm income | millions | $139 | $106 | $98 |
| Nonfarm | do | $3,276 | $3,573 | $3,930 |
| Mining total | do | $12 | $12 | $11 |
| Manufacturing total | do | $1,030 | $1,080 | $1,167 |
| Primary metal industries | do | $14 | $16 | $19 |
| Stone, clay, and glass products | do | $45 | $48 | $50 |
| Chemicals and allied products | do | $13 | $15 | $17 |
| Construction | do | $190 | $236 | $269 |
| Transportation and public utilities | do | $203 | $222 | $240 |
| Wholesale and retail trade | do | $518 | $563 | $629 |
| Finance, insurance, real estate | do | $139 | $160 | $183 |
| Services | do | $653 | $726 | $813 |
| Government and government enterprises | do | $514 | $556 | $598 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 2,210 | 2,881 | 6,122 |
| Value of nonresidential construction | millions | $131.5 | $87.3 | $82.7 |
| Value of State road contract awards | do | $41.0 | $30.5 | $42.5 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 114 | 137 | 149 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $39.1 | $42.1 | $45.1 |
| Value per capita | | $96 | $80 | $85 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

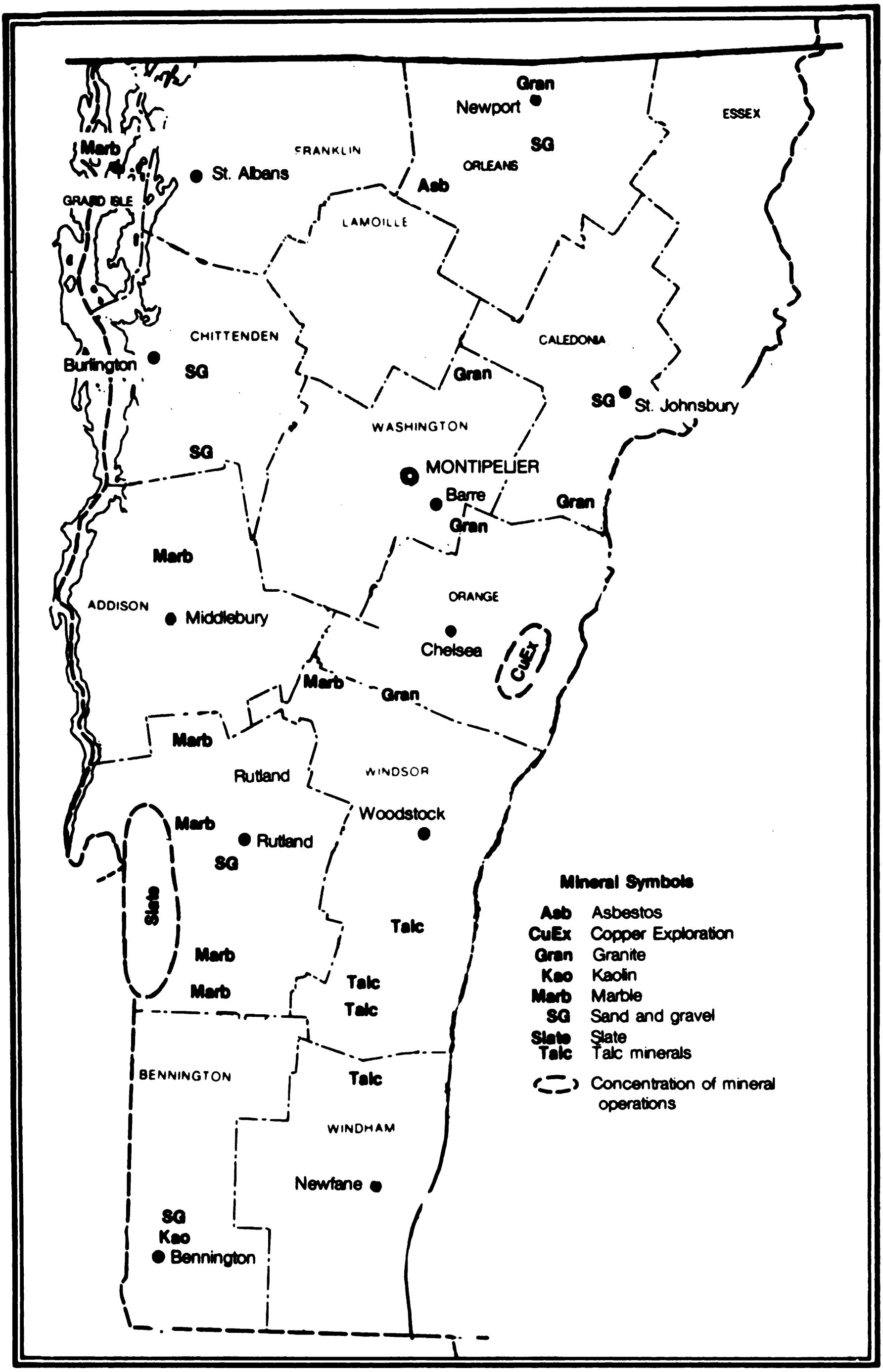

Figure 1.—Principal mineral producing localities in Vermont.

**Exploration Activities.**—Newmont Exploration Ltd. began an exploration program near Corinth in Orange County. Copper was last mined in the area at the Pike Hill Mines in 1919. Because of the low price of copper, speculation existed that the firm's prime interest was in the potential for gold, which is often associated with copper deposits. Company offers to lease mineral rights were rejected by a majority of landowners. Newmont's activity in the area was opposed by some of the residents, and at yearend, town officials were petitioned to consider adopting ordinances to ban open pit mining.

The Holland Co. of Adams, MA, completed exploration of a kaolin deposit on a 275-acre tract near Bennington. The firm's plan to mine kaolin—a fine white clay used as a filler by the paper, paint, and plastic industries—and operate a processing plant was under review by local planning and zoning officials. If approved, Holland must also apply for a mining permit under the State's land use and development law, known as Act 250.

Columbia Gas Transmission Co. intended to drill a 10,500-foot exploratory oil or natural gas well in Fairfield, but the hole was abandoned at a depth of 6,970 feet and plugged. Indications to that depth were that no potential existed for oil or gas. Unless released by the company, geologic information on the hole obtained from core samples remains confidential until October 1986, according to State law.

**Legislation and Government Programs.**—Public Act No. 207 provided $200,000 for operation of the State-owned St. Johnsbury and Lamoille County Railroad. Part of the funding was used for a market study to determine what additional materials could be transported on the 99-mile line that connects Swanton to St. Johnsbury. Dimension granite quarried at Woodbury and talc processed at a mill in Johnson were cited as commodities that potentially could be shipped cost effectively on the rail line.

During the year, the Office of the State Geologist, Agency of Environmental Conservation, continued to collect information on Vermont's metallic mineral resources for the U.S. Geological Survey's (USGS) Mineral Resource Data System. About 130 occurrences, prospects, and mines were located, and samples from approximately 90 sites were available for inspection at the University of Vermont Geology Department Museum. New bedrock and surficial geologic mapping was initiated also with the USGS under the Cooperative Geological Mapping Program. Published in 1984 was the "Bedrock Geology of the Brattleboro Quadrangle, Vermont-New Hampshire."[3]

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Asbestos.**—Shipments declined 40% in 1984 as domestic demand remained weak because of continued health-related concerns about asbestos products. As the market diminished for asbestos, the Vermont Asbestos Group Inc. has cut back mining operations at its Lowell Mine, Orleans County, shutting down from November until April for the past few years. A yearend stockpile of 6,500 short tons of asbestos, about 2,500 tons more than the anticipated inventory, was expected to delay resumption of mining in 1985 until at least May.[4]

**Sand and Gravel (Construction).**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of 3.8 million short tons of construction sand and gravel in 1984 was the highest total since 1973, when 4 million tons was produced. Significant increases in tonnage in comparison with 1983 totals were reported in Rutland County, 322,000 tons; Lamoille County, 225,000 tons; and Windsor County, 132,000 tons. Output decreased 225,000 tons in Chittenden County and 158,000 tons in Bennington County for the same time period. Shifts in production were indicative of trends in the construction industry, particularly roadbuilding and road maintenance in Vermont. The State's six leading sand and gravel producers accounted for more than one-half of Vermont's production and operated about 20% of the State's 80 active pits in 1984.

### Table 4.—Vermont: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 338 | $1,314 | $3.88 |
| Plaster and gunite sands | ([1]) | W | 5.00 |
| Concrete products | W | W | 4.01 |
| Asphaltic concrete | 330 | 616 | 1.87 |
| Road base and coverings | 694 | 1,075 | 1.55 |
| Fill | 248 | 332 | 1.34 |
| Snow and ice control | 117 | 248 | 2.12 |
| Railroad ballast | W | W | 4.03 |
| Other | 2,075 | 4,485 | 2.16 |
| Total or average | 3,802 | [2]8,071 | 2.12 |

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Less than 1/2 unit.
[2]Data do not add to total shown because of independent rounding.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—The State's crushed stone industry produced an estimated total of 1.8 million short tons of limestone, granite, and marble in 1984, an increase of about 460,000 tons compared with 1983 output. During the year, two companies received local government approval for mining stone. Thompson-Weinman & Co., a subsidiary of Cyprus Mines Corp., continued with plans to open a $30 million underground marble mine and surface processing plant for high-calcium ground products in Brandon. Shelburne Limestone Corp. planned to mine 20,000 tons of limestone annually from its Fonda Junction Quarry, south of Swanton. Both companies were in the process of obtaining the necessary permits under Act 250, the State's land use and development law. A third company, Crushed Rock Inc., opened a dolomite quarry in Clarendon, Rutland County, at yearend. Stone produced at the operation was expected to supplement diminishing sand and gravel resources in west-central Vermont.

*Dimension.*—Vermont produced an estimated 116,000 short tons (1.2 million cubic feet) of dimension stone, ranking fourth nationally in output. Rock of Ages Corp. (ROA), the State's major producer and one of the Nation's leading dimension granite producers, was purchased by John Swenson Granite Co. Inc. from Nortek Inc. for about $20 million. Most of the gray granite quarried by ROA in Barre was used to manufacture memorials and gravestones. Swenson Granite also began full-scale operation of its Woodbury quarries north of Barre. Expansion of the State Capitol Building in Harrisburg, PA, which was constructed in 1904 using Woodbury gray granite, resulted in an order for 160,000 cubic feet.

Wells-Lamson Quarry Co. reopened the Jones Bros. Quarry near Williamstown. Renewed interest in the quarry resulted from demand for a granite darker in color than the gray granite in Barre.

International Hydonics Corp. began testing a process to remove silicon carbide from granite sludge at a plant in Barre. Granite manufacturers have long used silicon carbide to cut the stone. Full-scale operation with capacity to recover 2,500 tons of silicon carbide annually was expected in the spring of 1985.[5]

**Talc.**—Output in 1984 remained about the same as in 1983 despite the permanent closing of Eastern Magnesia Talc Co.'s underground mine in Johnson late in 1983. In March, Acqui-Tal Inc., formed by European investors, purchased Eastern Magnesia's surface talc mill for $500,000 and invested nearly $1 million in renovating the plant. The improvements in processing enabled Acqui-Tal to manufacture cosmetic and industrial grades of talc; previously only an industrial grade of talc was processed at the Johnson mill. Talc was purchased by Acqui-Tal from OMYA Inc.'s mines in Windham.[6]

OMYA's plan to double the capacity of its mill in Chester was approved by the State. However, some local opposition to increased truck traffic was limiting utilization of that capacity; the dispute continued at yearend.

Cyprus Mines Corp. completed an extensive drilling and geologic appraisal program on a talc deposit in the Andover-Chester area (Smokeshire district). The program proved a substantial deposit of a high-purity talc existed. Additional testing and bulk sampling confirmed that appraisal. The firm signed a 4-year option agreement with

Chester town officials for the 350 acres where the talc was found and settled with a landowner who had also claimed ownership of the land. At yearend, a pre-permit mining plan and site engineering plan were in preparation.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] State geologist, Agency of Environmental Conservation, Montpelier, VT.

[3] Hepburn, J. C., N. J. Trask, J. L. Rosenfeld, and J. B. Thompson, Jr. The Bedrock Geology of the Brattleboro Quadrangle, Vermont-New Hampshire. Agency Environ. Conserv. Bull. 32; available for sale at Department of Libraries, Geologic Documents Section, 111 State St., Montpelier, VT 05602.

[4] Burlington (VT) Free Press. Vermont Asbestos Layoff Extended. Mar. 22, 1985, p. 1.

[5] The Times Argus (Barre-Montpelier, VT). Granite Sludge Operation Starts in Barre Under Watchfull Eyes. Sept. 19, 1984, p. 1.

[6] Burlington (VT) Free Press. Europeans Spend $1 Million To Revive Johnson Talc Mill. Dec. 21, 1984, p. 7.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Asbestos: | | | |
| Vermont Asbestos Group Inc | Box 54B<br>Morrisville, VT 05661 | Pit | Orleans. |
| Sand and gravel: | | | |
| Calkins Sand & Gravel Inc | Box 82<br>Lyndonville, VT 05851 | Pits and plant | Caledonia and Orleans. |
| Joseph P. Carrara & Sons Inc | Route 116<br>Middlebury, VT 05753 | Pits | Addison and Rutland. |
| William E. Daily Inc | Route 1, Box 51<br>Shaftsbury, VT 05262 | do | Bennington. |
| Hinesburg Sand & Gravel Co | Box 200<br>Hinesburg, VT 05461 | do | Chittenden. |
| Pike Industries Inc | Route 3<br>Tilton, NH 03276 | do | Addison, Caledonia, Windsor. |
| Frank W. Whitcomb Construction Corp. | Box 429<br>Bellows Falls, VT 05101 | Pit and plant | Rutland. |
| Stone: | | | |
| Crushed: | | | |
| Cooley Asphalt Paving Corp | Box 542<br>Barre, VT 05641 | Quarry | Washington. |
| Shelburne Limestone Corp | 30 Jewett<br>Swanton, VT 05488 | Quarries | Chittenden and Franklin. |
| Frank W. Whitcomb Construction Corp. | Box 429<br>Bellows Falls, VT 05101 | Quarry | Chittenden. |
| White Pigment Corp | Florence, VT 05744 | Quarries | Addison and Rutland. |
| Dimension: | | | |
| OMYA Inc | Box 10<br>Florence, VT 05744 | do | Rutland and Windsor. |
| Rock of Ages Corp., a subsidiary of John Swenson Granite Co. Inc. | Box 482<br>Barre, VT 05641 | do | Washington and Windsor. |
| John Swenson Granite Co. Inc | North State St.<br>Concord, NH 03301 | Quarry | Washington. |
| Talc: | | | |
| Acqui-Tal Inc | Box 559<br>Chester, VT 05089 | Mill | Lamoille. |
| OMYA Inc | Chester, VT 05143 | Mine and mill | Windham. |
| Windsor Minerals Inc | Windsor, VT 05089 | Mines and mills. | Windsor. |

# The Mineral Industry of Virginia

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Virginia Division of Mineral Resources for collecting information on all nonfuel minerals.**

By Doss H. White, Jr.,[1] and Palmer C. Sweet[2]

The value of nonfuel mineral production in Virginia in 1984 was $342 million. This value was $52 million over that reported in 1983 and established a new State record.

The State's extractive mineral industry produced 14 mineral commodities; stone, portland cement, and sand and gravel accounted for approximately three-fourths of the total sales reported within the industry. Virginia led the Nation in the production of kyanite and "Virginia aplite," a feldspar mineral, and ranked in the top 10 in lime sales. Virginia was one of three States with vermiculite mining. Virginia's mineral output consisted almost entirely of industrial minerals, ranking it among the leaders in the Eastern United States; however, in total mineral value the State ranked 23d.

**Table 1.—Nonfuel mineral production in Virginia[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | 784 | $5,467 | 712 | $6,004 |
| Gem stones | NA | 20 | NA | 20 |
| Lime thousand short tons | 557 | 24,637 | 562 | 24,799 |
| Sand and gravel (construction) do | [e]7,200 | [e]30,800 | 8,860 | 37,359 |
| Stone: | | | | |
| Crushed do | [r] [2]38,036 | [r]159,553 | [e]47,200 | [e]196,000 |
| Dimension do | [r] [2]16 | [r]2,238 | [e]22 | [e]3,052 |
| Combined value of aplite, cement, gypsum, iron oxide pigments (crude), kyanite, sand and gravel (industrial), talc (soapstone), and vermiculite | XX | 66,629 | XX | 74,355 |
| Total | XX | 289,344 | XX | 341,589 |

[e]Estimated. [r]Revised. NA Not available. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Data differ from those in the Statistical Summary owing to receipt of later information.

## Table 2.—Value of nonfuel mineral production in Virginia, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Accomack | W | (2) | |
| Albemarle | $55 | W | Stone (crushed). |
| Amelia | 71 | $71 | Clays. |
| Amherst | -- | W | Stone (crushed). |
| Appomattox | -- | W | Do. |
| Augusta | W | 2,679 | Do. |
| Bath | -- | W | Do. |
| Bedford | -- | W | Do. |
| Bland | -- | W | Do. |
| Botetourt | W | W | Cement, stone (crushed), clays. |
| Brunswick | (3) | W | Stone (crushed). |
| Buchanan | (3) | W | Do. |
| Buckingham | W | 10,773 | Kyanite, stone (dimension), stone (crushed). |
| Campbell | W | W | Stone (crushed). |
| Caroline | 805 | W | Do. |
| Carroll | -- | W | Do. |
| Charles City | W | (2) | |
| Chesapeake (city) | W | (2) | |
| Chesterfield | W | W | Stone (crushed), clays. |
| Clarke | (3) | W | Stone (crushed). |
| Craig | W | (2) | |
| Culpeper | (3) | W | Stone (crushed). |
| Dinwiddie | (3) | W | Do. |
| Fairfax | 10 | W | Do. |
| Fauquier | (3) | W | Stone (crushed), stone (dimension). |
| Franklin | W | W | Talc. |
| Frederick | W | 14,363 | Sand and gravel (industrial), stone (crushed), lime. |
| Giles | W | W | Lime, stone (crushed). |
| Gloucester | W | (2) | |
| Goochland | (3) | W | Stone (crushed). |
| Grayson | (3) | W | Do. |
| Greensville | W | W | Stone (crushed), clays. |
| Halifax | (3) | W | Stone (crushed). |
| Hanover | W | W | Stone (crushed), aplite, stone (dimension). |
| Henrico | 12,023 | 965 | Stone (crushed). |
| Henry | W | W | Do. |
| James City | W | (2) | |
| King and Queen | W | 2,000 | Clays. |
| King George | 1,979 | (2) | |
| King William | 32 | (2) | |
| Lancaster | W | (2) | |
| Lee | (3) | 1,881 | Stone (crushed). |
| Loudoun | (3) | 13,599 | Do. |
| Louisa | W | W | Vermiculite, stone (crushed). |
| Middlesex | 10 | (2) | |
| Montgomery | 26 | W | Stone (crushed), clays. |
| New Kent | W | (2) | |
| Northampton | 12 | (2) | |
| Northumberland | W | (2) | |
| Nottoway | (3) | (2) | Stone (crushed). |
| Orange | W | W | Stone (crushed), clays. |
| Pittsylvania | W | W | Stone (crushed). |
| Prince George | W | (2) | |
| Prince William | (3) | W | Stone (crushed), clays. |
| Pulaski | 372 | W | Iron oxide pigments. |
| Richmond (city) | W | -- | |
| Roanoke | 42 | W | Stone (crushed), clays. |
| Rockbridge | W | 789 | Do. |
| Rockingham | W | 1,800 | Stone (crushed). |
| Russell | (3) | 5,196 | Do. |
| Scott | (3) | W | Do. |
| Shenandoah | W | W | Lime, stone (crushed). |
| Smyth | W | W | Gypsum, clays. |
| Southampton | W | (2) | |
| Spotsylvania | W | W | Stone (crushed). |
| Stafford | W | W | Do. |
| Suffolk (city) | W | (2) | |
| Surry | 1 | (2) | |
| Sussex | W | (2) | |
| Tazewell | 4 | W | Stone (crushed), clays. |
| Virginia Beach (city) | W | W | Sand and gravel (industrial). |
| Warren | W | W | Cement, lime, stone (crushed). |
| Washington | (3) | 2,463 | Stone (crushed). |
| Westmoreland | W | (2) | |
| Wise | (3) | W | Stone (crushed). |
| Wythe | (3) | W | Stone (crushed), iron oxide pigments. |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Virginia, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Undistributed[4] | $104,312 | $201,964 | |
| Sand and gravel (construction) | XX | [e]30,800 | |
| Stone: | | | |
| Crushed | [e]142,300 | XX | |
| Dimension | [r] [e]1,151 | XX | |
| Total[5] | [r]263,204 | 289,344 | |

[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[4] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[5] Data do not add to totals shown because of independent rounding.

## Table 3.—Indicators of Virginia business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 5,485 | 5,556 | 5,636 |
| Total civilian labor force | do | 2,650 | 2,722 | 2,841 |
| Unemployment | do | 204 | 165 | 143 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 22.1 | 17.4 | 18.1 |
| Nonmetallic minerals except fuels | do | NA | 2.3 | 2.3 |
| Coal mining | do | 19.3 | 14.9 | 15.5 |
| Oil and gas extraction[2] | do | .3 | .2 | NA |
| Manufacturing total | do | 397.2 | 403.6 | 420.1 |
| Primary metal industries | do | 10.6 | 10.1 | 10.9 |
| Stone, clay, and glass products | do | 11.6 | 12.4 | 13.5 |
| Chemicals and allied products | do | 32.9 | 32.3 | 32.7 |
| Petroleum and coal products[2] | do | .4 | .4 | NA |
| Construction | do | 103.8 | 113.9 | 131.8 |
| Transportation and public utilities | do | 119.0 | 120.4 | 127.6 |
| Wholesale and retail trade | do | 462.4 | 480.2 | 513.0 |
| Finance, insurance, real estate | do | 106.9 | 110.1 | 117.2 |
| Services | do | 434.8 | 460.4 | 492.8 |
| Government and government enterprises | do | 500.1 | 500.9 | 504.4 |
| Total | do | [3]2,146.4 | 2,206.9 | 2,325.0 |
| Personal income: | | | | |
| Total | millions | $62,375 | $67,715 | $74,694 |
| Per capita | | $11,371 | $12,188 | $13,254 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.4 | 39.7 | 40.3 |
| Total average hourly earnings, production workers | | $7.37 | $7.79 | $8.12 |
| Earnings by industry: | | | | |
| Farm income | millions | $316 | $225 | $345 |
| Nonfarm | do | $42,703 | $46,901 | $52,206 |
| Mining total | do | $684 | $544 | $635 |
| Nonmetallic minerals except fuels | do | $44 | $46 | $53 |
| Coal mining | do | $626 | $486 | $569 |
| Oil and gas extraction | do | $15 | $9 | $12 |
| Manufacturing total | do | $8,036 | $8,774 | $9,707 |
| Primary metal industries | do | $284 | $305 | $349 |
| Stone, clay, and glass products | do | $229 | $257 | $298 |
| Chemicals and allied products | do | $908 | $967 | $1,047 |
| Petroleum and coal products | do | $15 | $16 | $18 |
| Construction | do | $2,123 | $2,465 | $2,976 |
| Transportation and public utilities | do | $3,258 | $3,641 | $4,074 |
| Wholesale and retail trade | do | $6,284 | $6,880 | $7,765 |
| Finance, insurance, real estate | do | $1,864 | $2,197 | $2,543 |
| Services | do | $7,934 | $9,039 | $10,295 |
| Government and government enterprises | do | $12,397 | $13,215 | $14,047 |

See footnotes at end of table.

**Table 3.—Indicators of Virginia business activity —Continued**

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Construction activity: | | | |
| Number of private and public residential units authorized | 29,940 | 53,773 | 61,519 |
| Value of nonresidential construction millions | $1,152.7 | $1,409.3 | $1,886.7 |
| Value of State road contract awards do | $214.2 | $261.0 | $773 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,465 | 1,793 | 2,112 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $263.2 | $289.3 | $341.6 |
| Value per capita | $48 | $52 | $61 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

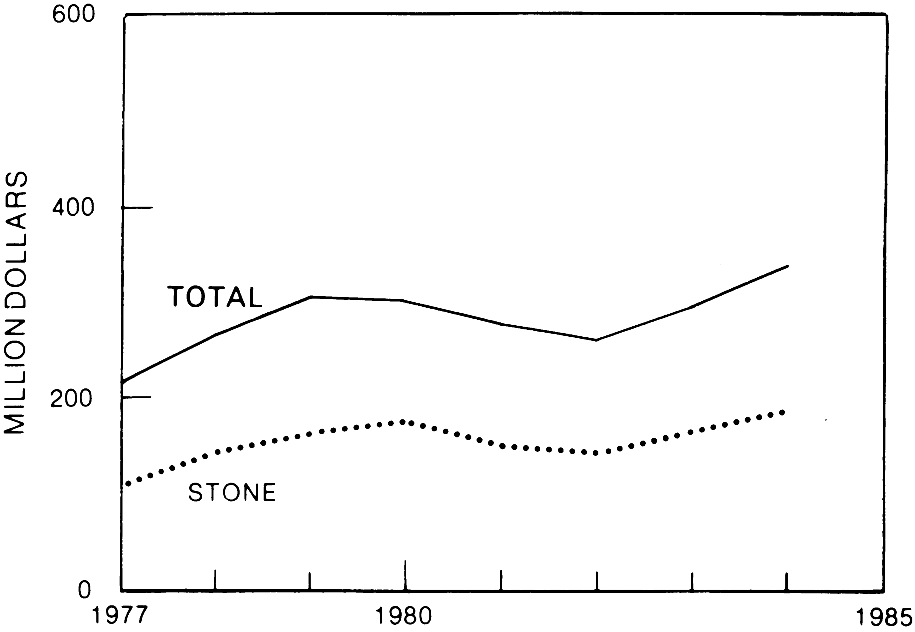

Figure 1.—Value of stone and total value of all nonfuel mineral production in Virginia.

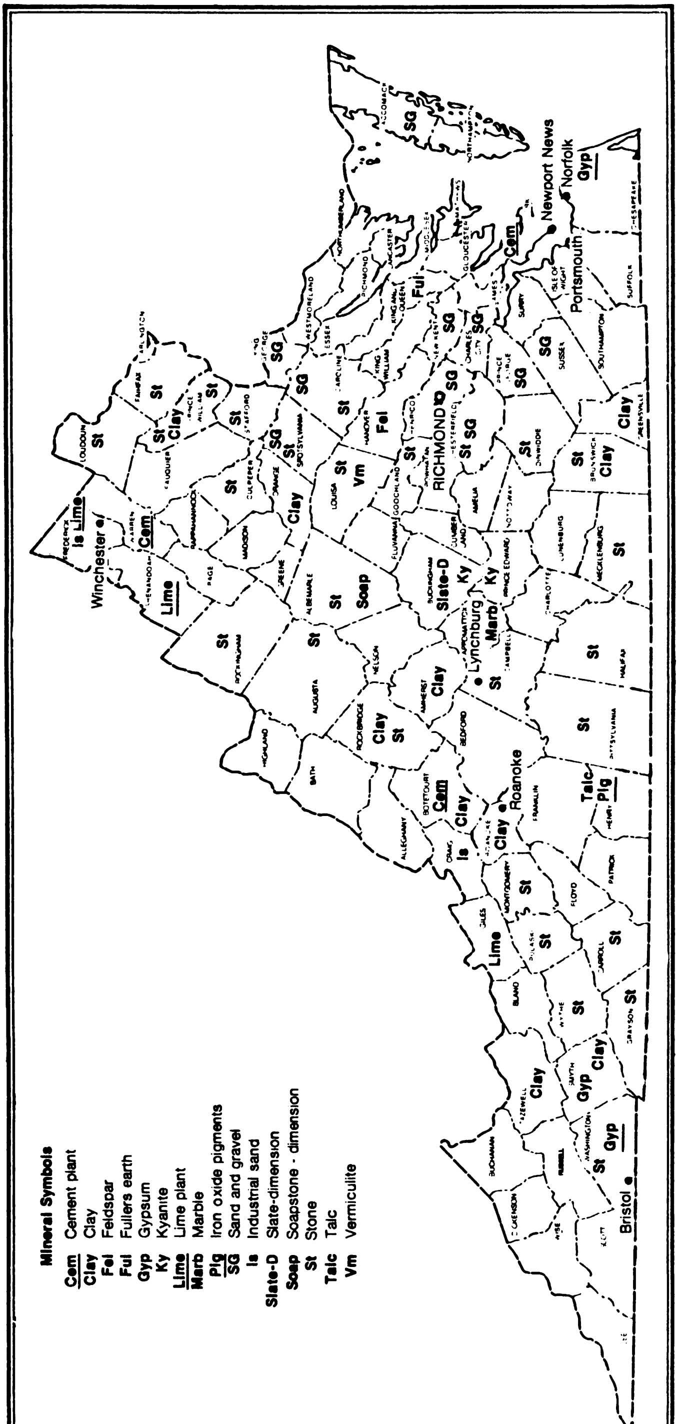

Figure 2.—Principal mineral producing localities in Virginia.

**Trends and Developments.**—The year marked the second consecutive year that nonfuel mineral value increased and the value of fuels output fell. Nonfuel mineral industry sales were buoyed by a strong demand for construction mineral commodities, cement, clays, sand and gravel, and stone, which resulted from the continued demand for new commercial and residential construction. A depressed market for steam and coking coal, increased inroads by foreign coal producers on Virginia export markets, and a continued downward trend in domestic petroleum usage all contributed to the decline in fuel sales.

The year witnessed the addition of a new, nonfuel mineral operation and new life for two operations closed during the early 1980's. United Fiberglass Inc., using stone, feldspar, glass sand, and a borate mineral, began manufacturing home insulation at a plant in northern Virginia. Texasgulf Chemicals Co. began producing animal feed supplement using phosphate rock, phosphoric acid, and calcium carbonate at the former plant of Greer Lime Co. at Saltville. Country Crafts began manufacturing hand and bed warmers from soapstone quarried in the Schuyler area.

**Legislation and Government Programs.**—A major reorganization of Virginia's government was passed by the 1984 legislature, to become effective January 1, 1985. Three new departments were created in the reorganization, the resource development department being Mines, Minerals and Energy. This combined the former Divisions of Mineral Resources, Mined Land Reclamation, Mines, and Energy.

The State's Uranium Task Force recommended that the General Assembly lift the moratorium on uranium mining in Virginia, provided that guidelines drafted by the Task Force are followed. One recommendation limited personal radiation exposure to 285 millirems annually; Federal limits are 5,000 millirems per year. A second recommendation would prohibit ground water contamination in the vicinity of the mining-milling complex.

The Task Force recommendations followed 3 years of study prompted by the efforts of Marline Uranium Corp. and Umetco Minerals Corp. to mine and process approximately 30 million pounds of uranium ore in Pittsylvania County in the southern part of the State.

Virginia Polytechnic Institute and State University (VPI) continued work on coal research funded by the Federal and State governments and private industry. Among the areas under investigation were the chemistry of coal, surface mining and reclamation methods, and underground mine roof control.

In August, VPI hosted the 15th Annual Institute on Coal Mining Health, Safety and Research. Among the speakers at the 2-day meeting were the Chief Counsel of the National Independent Coal Operators Association and a member of the Executive Coal Council of Yugoslavia.

A study, financed by a $36,000 grant by the U.S. Department of Energy, was begun by VPI's Center for Coal and Energy Research. The study will investigate the decline in Virginia's share of the U.S. coal market. The State's share of the U.S. market has decreased from 5% to 4% and the central Appalachian market share was down to 12.8% from a high of 15%.

The Virginia Division of Mineral Resources celebrated its sesquicentennial anniversary in 1984. The Division's four sections, Mineral Resources, Geological Support, Geologic Mapping, and Information Services, were active in many areas of the State.

The Mineral Resources Section maintained liaison with the mineral industry and completed a State Minerals Management Plan for Virginia. This section, in cooperation with the U.S. Geological Survey, published a report, "Selected Virginia Mineral-Resource Information," and also completed six mineral resource studies. At yearend, work was ongoing on a study of carbonate rocks in Virginia and two geochemical and six mineral resource studies.

A cooperative program between the Division and the U.S. Bureau of Mines provided for the analyses of clay and limestone samples from Virginia, as well as the sharing of mineral production and value data collected by the Bureau of Mines.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

The value of nonfuel mineral production in 1984 exceeded the record high established by Virginia's mineral industry in 1979 by $31.8 million. The three leading commodities in 1984, based on the reported value, were stone, portland cement, and sand and gravel. These three accounted for over three-quarters of the value reported by the State's mineral industry.

**Aplite.**—The Hanover-Amherst Counties area in eastern Virginia contains a feldspar mineral that has been termed "Virginia aplite." This term was adopted because of a difference in rail tariffs between feldspar and aplite, the latter being less costly to ship than feldspar. In 1984, two companies mined and processed "aplite" for glass and aggregate applications.

The Feldspar Corp. operated a surface mine and beneficiation plant in Hanover County. The material was crushed, screened, and passed through Humphrey spirals and a wet magnetic separator to produce a product with the approximate analysis of 22% $Al_2O_3$, 2.6% $K_2O$, and 6% $Na_2O$. The primary sales were to the manufacturers of glass containers for the beer industry.

A second company, Dominion Stone Plant Inc., mined feldspar (aplite) in Amherst County. The material was produced by surface mining, then crushed and screened to produce a variety of products that included construction aggregate and a material used in insulation and solar heating.

**Cement.**—Virginia's cement industry, made up of three companies, operated seven kilns to produce portland, masonry, and calcium aluminate cement. Lone Star Cement Inc. operated five kilns, and Lone Star Lafarge Inc. and Riverton Corp. operated one kiln each. Production increased approximately 15% over that reported in 1983.

Lone Star Cement produced portland and masonry cement in western Virginia from an Ordovician limestone and shale. Mill scale for the cement manufacturing process was purchased from Roanoke Electric Steel Corp.

Lone Star Lafarge produced calcium aluminate cement at Chesapeake on the Virginia coast. This was one of three calcium aluminate cement plants in the United States.

Riverton operated a masonry cement plant in northern Virginia using purchased portland cement and locally mined limestone. The company also mined and crushed a non-cement-grade limestone for aggregate sales.

A portion of the cement for the southern part of the State was supplied by a new Atlantic cement distribution terminal opened in Durham, NC. The facility supplies New Cem, a finely ground water-granulated blast furnace slag produced at Sparrows Point, MD.

**Clays.**—Virginia clay producers accounted for 2% of the State's mineral value during 1984. The industry was comprised of 10 companies, operating 14 mines in a 13-county area. Clay and shale were produced in two distinct geographical areas in the State: the southwest and eastern Virginia, including the city of Richmond.

The State's brick industry consisted of 7 companies operating 10 pits. Brick production accounted for 82% of the common clay and shale produced in the State. Expanded shale or lightweight aggregate production used in manufacturing concrete block and structural concrete products accounted for the remainder.

Southwestern Virginia clay firms produced a variety of common and face brick as well as several types of fired clay products using Paleozoic shales and clays as the principal raw material. Clay firms in eastern Virginia mined a variety of metamorphic and weathered metamorphic rock units as a raw material for the manufacture of brick and clay products.

Bennett Minerals Co., King and Queen County, mined a montmorillonite clay as raw material for the production of industrial and pet waste adsorbents. The company used wood waste products as a kiln fuel. Tazewell Clay Products Co. mined a local shale to produce clay dummies used for blasthole stemming in coal mines, and the Weblite Corp. mined the Rome Formation to produce an expanded shale product.

In midyear, Glen-Gery Brick Co. announced a $2.5 million expansion at its two-kiln Manassas plant. The first phase of the expansion, housed in a 12,000-square-foot plant addition, is to include modernization of the grinding area, the addition of a new brick press and associated brick-handling equipment, and a multicharge dryer designed for molded brick. The second phase will include renovating and expanding the sales and product show areas. Completion is scheduled for the spring of 1985. Plant capacity will be increased from

36 to 72 million brick when the work is completed.

Locher Brick Works Inc., in Madison Heights, converted its brick plant to use coal as the primary fuel. The facility, with an annual capacity of 36 million brick per year, uses 14 to 15 tons of coal per day.

### Table 4.—Virginia: Clays sold or used by producers

(Thousand short tons and thousand dollars)

| Year | Quantity | Value |
|---|---|---|
| 1980 | 762 | 3,172 |
| 1981 | 502 | 2,016 |
| 1982 | 422 | 2,237 |
| 1983 | 784 | 5,467 |
| 1984 | 712 | 6,004 |

**Gypsum.**—The only underground gypsum mine in the Atlantic Coast States was operated by United States Gypsum Co. at Locust Cove in western Virginia. The mine produced feed for a gypsum board plant at Plasterco, which produced both a standard and a vinyl clad wallboard. The company also operated a wallboard plant at Norfolk using gypsum shipped by freighter from company mines in Canada. Anhydrite from the Canadian mines was imported into the State and sold as a set retarder for cement manufacture.

**Iron Oxide Pigments.**—Virginia was one of three States with extractive iron oxide pigment production. Hoover Color Corp. mined crude pigments for a variety of industrial uses. Virginia Earth Pigments Co. produced a small tonnage of material, which was purchased by Hoover. Hoover also imported both natural and synthetic pigment material.

Blue Ridge Talc Co. Inc. purchased out-of-State iron ore for grinding into pigment. Much of the company's production was used in-house in paint production.

**Kyanite.**—The world's largest kyanite mine is operated by Kyanite Mining Corp. on East Ridge near Dillwyn, Buckingham County. The company also produces kyanite from a mine on adjacent Willis Mountain. The company mines a kyanite-bearing quartzite, which is crushed and ground to minus 35 mesh. The ground material is feed for a flotation process that yields a concentrate containing 90%+ kyanite. Magnetic separation is used to remove most iron contaminants. The company also produces a 48-, 100-, 200-, and 325-mesh kyanite and mullite product.

Approximately 35% of the company's production is shipped to foreign customers through the Port of Hampton Roads. Much of the output for domestic markets is trucked to Dillwyn and shipped by rail. The Virginia operation is one of two in the United States producing kyanite.

**Lime.**—Virginia, with enormous resources of high-purity limestone, is one of the leading lime producers in the Eastern United States. In 1984, the State ranked 10th among 38 lime-producing States. Chemstone Corp. near Strasburg, W. S. Frey Co. Inc. at Clearbrook, and U.S. Gypsum and Virginia Lime Co., both at Ripplemead, comprise the State's commercial lime industry. Chemstone and Frey operated surface mines and lime plants in Shenandoah County, and U.S. Gypsum and Virginia Lime operated underground room-and-pillar mines in Giles County. Riverton operated a surface mine and lime plant near Riverton in Warren County and produced a hydraulic hydrated lime for use in the manufacture of masons' mortar. A sixth lime producer, Greer Lime at Saltville, which closed in 1982, was sold to Texasgulf, which plans to use the plant for production of a phosphate-based animal feed supplement.

### Table 5.—Virginia: Lime sold or used by producers, by use

| Use | 1983 Quantity (short tons) | 1983 Value (thousands) | 1984 Quantity (short tons) | 1984 Value (thousands) |
|---|---|---|---|---|
| Paper and pulp | 149,756 | $6,054 | 183,179 | $7,391 |
| Steel, basic oxygen furnace | 122,921 | 5,048 | 106,446 | 4,558 |
| Water purification | 105,437 | 5,099 | 70,936 | 3,231 |
| Acid water, neutralization | 46,852 | 2,156 | 43,771 | 1,830 |
| Steel, electric | 30,927 | 1,259 | W | W |
| Other[1] | 101,092 | 5,021 | 157,953 | 7,789 |
| Total | 556,985 | 24,637 | 562,285 | 24,799 |

W Withheld to avoid disclosing company proprietary data.

[1] Includes alkalies, calcium aluminate cement, citric acid, chrome, fertilizer, animal and human food (1983), insecticides (1984), insulation (1984), open-hearth steel, other chemical and industrial uses, other metallurgy, paint (1984), precipitated calcium carbonate (1984), road stabilization, soil stabilization, sugar refining (1983), tanning, and use indicated by symbol W.

**Lithium Compounds.**—Sunbright was the site of a lithium hydroxide plant operated by Foote Mineral Co. The southwestern Virginia plant shipped lithium carbonate from Foote's mining-processing complex at Kings Mountain, NC. Output from the Sunbright plant was used in multipurpose grease manufacture.

**Mica.**—Asheville Mica Co. and an affiliate, Mica Co. of Canada, operated mica fabricating plants at Newport News. Crude sheet mica was imported from Madagascar and India and was used by Asheville Mica to produce fabricated mica products. Splittings from the Asheville operation were used by Mica Co. of Canada to produce reconstituted mica. Scrap from the operation was shipped to a company plant at Asheville, NC, for grinding. Mica washers were also imported.

**Perlite (Expanded).**—New Mexico perlite, a volcanic rock that expands when heated, was shipped into Virginia by Manville Building Materials Corp. as raw material for insulation manufacture. The company operated a plant at Woodstock in Shenandoah County where the rock was expanded and used as a component in the manufacture of roof insulation board.

Texasgulf purchased and began renovating the Greer Lime plant at Saltville in Smyth County in the southwestern part of the State. The plant is designed to use phosphate rock shipped by rail from the company's mining and beneficiation complex at Lee Creek, NC, to produce an animal and poultry feed supplement. The former lime company kilns are being used to defluorinate the phosphate rock prior to adding other ingredients to create a balanced supplement. Plant and kiln renovation are scheduled for completion by late summer 1985.

**Sand and Gravel.**—Virginia's sand and gravel industry, 54 companies operating 67 mines in 35 counties or cities, reported sales in excess of $37 million.

*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Most of Virginia's sand and gravel output was for the construction market. The construction sand and gravel industry consisted of 51 companies operating 64 mines in a 34-county area. Construction sand and gravel production and value increased 1.7 million tons and $6.6 million, respectively, above that estimated for 1983.

**Table 6.—Virginia: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,035 | $15,682 | $5.17 |
| Plaster and gunite sands | W | W | 4.44 |
| Concrete products | 1,483 | 8,944 | 6.03 |
| Asphaltic concrete | 423 | 1,501 | 3.55 |
| Road base and coverings | 723 | 3,556 | 4.92 |
| Fill | 327 | 664 | 2.03 |
| Snow and ice control | W | W | 5.65 |
| Other[1] | 2,868 | 7,013 | 2.44 |
| Total[2] or average | 8,860 | 37,359 | 4.22 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Includes roofing granules, other unspecified uses, and data indicated by symbol W.

[2] Data do not add to totals shown because of independent rounding.

*Industrial.*—The State's industrial sand industry consisted of three companies producing a variety of industrial sand products in Campbell and Frederick Counties and in the city of Virginia Beach. Production fell approximately 18% below the 1983 level and value dropped over $0.7 million. Sales to container and flat glass manufacturers comprised over 75% of the total sand produced. Other markets included molding sand, specialty products, chemical usage, and traction applications.

**Slag—Steel.**—Slag, a waste product of the State's two steel mills, was sold for aggregate by individual contractors.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

*Crushed.*—The "Directory of the Mineral Industry in Virginia," published by the Virginia Division of Mineral Resources, lists approximately 110 crushed stone producers mining and crushing a variety of stone types, primarily for aggregate. Several companies are mining and crushing stone for a variety of nonaggregate applications.

In January 1983, the Loudoun County Board of Zoning Appeals approved by special exception a 66-acre quarry expansion by Bull Run Stone Co. Inc. In 1984, the company had planned to install crushing and screening equipment, but the Bull Run Civic Association protested the use of the machinery in this area. The board indicated a ruling will not be forthcoming before 1985.[3]

In November, the Powhatan County Board of Supervisors approved a $3 million revenue bond issuance to Luck Stone Corp. for development of a quarry in eastern Powhatan County.[4] The Powhatan quarry, tentatively scheduled for operation in mid-1985, will require an investment of $5 to $6 million and will employ about 20 people.[5]

United Fiberglass began operations of a manufacturing plant for home insulation at a site in Woodbridge, Prince William County, in northern Virginia. The company used a ground dolomite purchased from a Virginia supplier and feldspar, glass sand, and a borate mineral from out-of-State sources. These materials were melted in an electric furnace to produce a rock wool used in home insulation.

**Table 7.—Virginia: Principal crushed stone producing counties in 1984**

| County | Number of companies | Stone type | County | Number of companies | Stone type |
|---|---|---|---|---|---|
| Albemarle | 2 | Basalt and granite. | Lee | 3 | Limestone. |
| Amherst | 2 | Slate and feldspar. | Loudoun | 5 | Diabase. |
| Appomattox | 5 | Limestone.[1] | Louisa | 1 | Granite. |
| Augusta | 2 | Limestone. | Montgomery | 2 | Limestone. |
| Botetourt | 3 | Do. | Nottoway | 2 | Granite. |
| Brunswick | 2 | Granite. | Pittsylvania | 1 | Sandstone. |
| Buckingham | 1 | Slate. | Prince William | 2 | Basalt and diabase. |
| Caroline | 1 | Granite. | Pulaski | 2 | Limestone. |
| Chesterfield | 2 | Do. | Richmond (city) | 1 | Granite. |
| Culpeper | 3 | Diabase and sandstone. | Roanoke | 1 | Limestone. |
| Dinwiddie | 1 | Granite. | Roanoke (city) | 1 | Do. |
| Fairfax | 2 | Granite and diabase. | Rockbridge | 2 | Do. |
| Fauquier | 3 | Basalt. | Rockingham | 4 | Do. |
| Floyd | 1 | Amphibolite. | Russell | 5 | Do. |
| Frederick | 4 | Limestone. | Scott | 1 | Do. |
| Goochland | 3 | Granite. | Shenandoah | 1 | Do. |
| Grayson | 1 | Basalt. | Spotsylvania | 1 | Granite. |
| Greene | 1 | Granite. | Stafford | 1 | Do. |
| Greensville | 1 | Do. | Tazewell | 4 | Limestone. |
| Halifax | 1 | Do. | Warren | 1 | Do. |
| Hanover | 1 | Do. | Washington | 3 | Do. |
| Harrisonburg (city) | 1 | Limestone. | Wise | 2 | Do. |
| Henrico | 1 | Granite. | Wythe | 5 | Do. |
| Henry | 2 | Do. | | | |

[1] Includes marble.

*Dimension.*—Eight companies produced dimension stone in 1984 according to the Virginia Division of Mineral Resources. Based on a partial year response by the industry, the U.S. Bureau of Mines estimated that value increased $800,000 above the value reported in 1983. Pertinent data on dimension stone production are presented in table 8.

Flagstone was produced from quartzite in the Weverton Formation by two companies operating in Campbell and Fauquier Counties. The State's intermittently active soapstone industry was reactivated when one company, Country Crafts, began marketing bed and hand warmers fabricated from the soapstone quarried from the Schuyler area.

**Table 8.—Virginia: Dimension stone producing counties in 1984**

| County | Number of quarries | Stone type |
|---|---|---|
| Albemarle | 1 | Soapstone. |
| Buckingham | 2 | Slate. |
| Campbell | 1 | Quartzite. |
| Culpeper | 1 | Diabase. |
| Fauquier | 2 | Quartzite. |
| Hanover | 1 | Granite. |
| Nelson | 1 | Soapstone. |

**Sulfur (Recovered).**—York County was the site of Amoco Oil Co.'s crude oil refinery. Sulfur was recovered by the Claus process and sold for use in acid production for fertilizer manufacture.

**Talc.**—A talc chlorite dolomite schist was mined under contract and ground and bagged by Blue Ridge Talc at a plant on the Henry-Franklin County boundary. The bagged talc was sold as a mold release agent for the foundry industry. The company also ground an iron ore for pigment manufacture.

**Vermiculite.**—Virginia is one of three States with vermiculite production. Virginia Vermiculite Ltd. operated a surface mine and processing plant near Boswell's Tavern in Louisa County. After processing, the vermiculite was marketed unexfoliated. Major sales were to a fertilizer manufacturer and to greenhouses equipped with exfoliation furnaces.

## METALS

All metals processed within the State were obtained from other States or foreign sources. The continued improvement of the Nation's economy had a positive effect on the demand for and sales of many of the products of Virginia's metal producers.

**Ferroalloys.**—Chemstone, a subsidiary of Engelhard Corp., had a ferrovanadium plant at Strasburg that closed in 1982 because of the weakened demand for alloys in specialty steel. In 1984, the lime and limestone assets of the company were sold to an affiliate of the Meriwether Capital Corp., which will continue to use the Chemstone name. The plant remained on the market at yearend.

**Gold.**—Walnut Creek Mining Inc. continued as the only gold panning operation in Virginia. The company operated a mine and panning shed in Orange County and owns two other mines, the Moss and Goochland, in Goochland County. The company used a small jaw crusher and a ball mill to produce an auriferous concentrate that is sold to tourists for panning or is processed by the company using Deister tables and an amalgamation drum.

Hoover and Strong Inc. in Richmond operated a precious metals refinery and jewelry company. Refined gold was purchased from the Homestake Mine in South Dakota, and gold and silver refined from scrap are used to produce a variety of precious metal products. The plant contains an assaying lab and scrap receiving-preparation, refining, melting, and alloying areas.

**Iron and Steel.**—Iron products were cast at several foundries operating in various areas of the State. The 1984 Industrial Directory of Virginia lists 17 gray iron foundries; 8 are situated in the Chesterfield, Campbell, and Roanoke County areas.

Steel was produced by Roanoke Electric Steel and Intercoastal Steel Corp. The two firms operated a total of six electric furnaces. In the third quarter, Roanoke Electric Steel, a producer of merchant bars, flats, and angles, was operating at 20 turns in both the melt shop and rolling mill.[6]

**Magnetite.**—Reiss Viking Corp. operated a magnetite grinding facility in Tazewell County to produce a product used in coal preparation plants. The company's sales area included Alabama, Kentucky, Tennessee, and Virginia.

**Manganese.**—Union Carbide Corp. imported manganese ore from Gabon as feed for a grinding plant at Newport News in eastern Virginia. After grinding, the material was shipped by rail to other Union Carbide plants for use in the manufacture of dry cell batteries.

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[1] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL.

[2] Head geologist, Economic Geology Section, Virginia Division of Mineral Resources.

[3] Loudoun Times-Mirror. BZA Postpones Action on Quarry. Nov. 22, 1984.

[4] Richmond News Leader. Powhatan Approves Stone Quarry Bonds. Nov. 20, 1984.

[5] ———. Luck Stone Hits Rich Vein. Dec. 3, 1984.

[6] American Metal Market. Summer Slack Restricts Output. July 27, 1984.

## Table 9.—Principal producers

| Commodity and company | Address | Type of activity | County or city |
|---|---|---|---|
| Aplite: | | | |
| The Feldspar Corp | Route 1, Box 23<br>Montpelier, VA 23192 | Quarry and plant | Hanover. |
| Cement: | | | |
| Lone Star Cement Inc.[1] | Box 27<br>Cloverdale, VA 24077 | do | Botetourt. |
| Lone Star Lafarge Inc | Box 5128<br>Chesapeake, VA 23320 | Plant | Chesapeake (city). |
| Riverton Corp.[2] | Riverton, VA 22651 | Quarry and plant | Warren. |
| Clays: | | | |
| Brick and Tile Corp | Box 45<br>Lawrenceville, VA 23868 | Pits and plant | Brunswick and Greensville. |
| General Shale Products Corp | Box 3547<br>Johnson City, TN 37601 | do | Rockbridge, Smyth, Tazewell. |
| Webster Brick Co. Inc | Box 12887<br>Roanoke, VA 24029 | do | Botetourt and Orange. |
| Gypsum: | | | |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Norfolk (city). |
| Do | Route 1<br>Saltville, VA 24370 | Mine and plant | Smyth and Washington. |
| Iron oxide pigments (crude): | | | |
| Hoover Color Corp | Box 218<br>Hiwassee, VA 24347 | do | Pulaski. |
| Kyanite: | | | |
| Kyanite Mining Corp | Dillwyn, VA 23936 | Mines and plant<br>Plant | Buckingham.<br>Prince Edward. |
| Lime: | | | |
| Chemstone Corp | Menlo Park<br>Edison, NJ 08817 | do | Shenandoah. |
| United States Gypsum Co | 101 South Wacker Dr.<br>Chicago, IL 60606 | do | Giles. |
| Virginia Lime Co | Route 635<br>Ripplemead, VA 24150 | do | Do. |
| Sand and gravel (construction): | | | |
| Lone Star Industries Inc | Box 420<br>Norfolk, VA 23501 | Pits and plant | Charles City, Chesterfield, Henrico, Prince George. |
| Sadler Materials Corp | Box 5607<br>Virginia Beach, VA 23455 | Pits | Henrico. |
| West Sand and Gravel Co. Inc | Box 6008<br>Richmond, VA 23222 | do | Henrico and Rockingham. |
| Stone (crushed): | | | |
| Lone Star Industries Inc | Box 420<br>Norfolk, VA 23501 | Quarries | Botetourt, Charles City, Chesterfield, Dinwiddie, Henrico, Prince George. |
| Luck Stone Corp | Box 29682<br>Richmond, VA 23259 | do | Albemarle, Augusta, Fairfax, Goochland, Loudoun, Nottoway, Rockingham. |
| Vulcan Materials Co., Mideast Div | Box 4195<br>Winston Salem, NC 27105 | do | Brunswick, Fairfax, Goochland, Halifax, Pittsylvania, Prince William, Stafford. |
| Talc: | | | |
| Blue Ridge Talc Co. Inc.[3] | Box 39<br>Henry, VA 24102 | Quarry and plant | Franklin. |

[1] Also sand and gravel and stone.
[2] Masonry cement only; also produces limestone and lime.
[3] Also finished iron oxide pigments.

# The Mineral Industry of Washington

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Washington Division of Geology and Earth Resources for collecting information on all nonfuel minerals.**

## By William L. Rice[1] and Bonnie Butler Bunning[2]

Washington's nonfuel mineral production value rose in 1984 to $203 million, an increase of 8% from the $187 million recorded in 1983. Industrial minerals accounted for 95% of the total nonfuel value for the year; gold and silver made up the remainder. Sand and gravel was the leading commodity produced in terms of value, followed by cement, stone, lime, and diatomite. Washington ranked 33d in the Nation in the value of its nonfuel minerals production for 1984.

**Table 1.—Nonfuel mineral production in Washington[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | 282 | [2]$1,715 | 292 | $1,646 |
| Gem stones | NA | 200 | NA | 200 |
| Sand and gravel: | | | | |
| Construction thousand short tons | [e]15,800 | [e]50,300 | 23,369 | 61,070 |
| Industrial do. | 337 | 4,581 | 356 | 5,201 |
| Stone: | | | | |
| Crushed do. | 10,451 | 29,607 | [e]10,400 | [e]31,700 |
| Dimension do. | 1 | 37 | -- | -- |
| Combined value of barite, cement, clays (fire clay, 1983), diatomite, gold, gypsum, lime, olivine, peat, silver, and talc | XX | 101,025 | XX | 102,807 |
| Total | XX | 187,465 | XX | 202,624 |

[e]Estimated. NA Not available. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fire clay; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in Washington, by county

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adams | $135 | W | Stone (crushed). |
| Asotin | W | $57 | Do. |
| Benton | W | 2,774 | Do. |
| Chelan | W | W | Sand (industrial). |
| Clallam | W | W | Clays, stone (crushed). |
| Clark | 1,151 | W | Stone (crushed), clays. |
| Columbia | -- | 105 | Stone (crushed). |
| Cowlitz | (1) | 385 | Do. |
| Douglas | -- | 565 | Do. |
| Ferry | W | W | Gold, silver, stone (crushed). |
| Franklin | W | 106 | Stone (crushed). |
| Garfield | -- | 76 | Do. |
| Grant | W | W | Diatomite, stone (crushed). |
| Grays Harbor | 2,069 | 676 | Stone (crushed). |
| Island | 350 | (2) | |
| Jefferson | 34 | W | Stone (crushed). |
| King | 63,186 | W | Cement, stone (crushed), sand (industrial), clays, peat. |
| Kitsap | 1,659 | W | Stone (crushed). |
| Kittitas | W | W | Stone (crushed), gold. |
| Klickitat | W | W | Stone (crushed). |
| Lewis | W | 928 | Do. |
| Lincoln | 718 | 790 | Do. |
| Mason | (1) | -- | |
| Okanogan | 310 | 257 | Stone (crushed), peat, gypsum. |
| Pacific | (1) | 829 | Stone (crushed). |
| Pend Oreille | W | W | Cement, stone (crushed). |
| Pierce | 12,247 | W | Lime, stone (crushed), clays, peat. |
| San Juan | 1,814 | (2) | |
| Skagit | 1,552 | 2,159 | Olivine, stone (crushed), stone (dimension). |
| Skamania | 66 | W | Stone (crushed). |
| Snohomish | 2,860 | 3,840 | Do. |
| Spokane | 416 | 3,023 | Do. |
| Stevens | 4,968 | 13,459 | Lime, sand (industrial), stone (crushed), stone (dimension), barite. |
| Thurston | 1,042 | W | Stone (crushed). |
| Wahkiakum | (1) | W | Do. |
| Walla Walla | W | (2) | |
| Whatcom | W | W | Cement, stone (crushed). |
| Whitman | (1) | 1,258 | Stone (crushed). |
| Yakima | 921 | 94 | Do. |
| Undistributed[3] | 50,409 | 105,781 | |
| Sand and gravel (construction) | XX | [e]50,300 | |
| Stone: | | | |
| Crushed | [e]23,800 | XX | |
| Dimension | [r] [e]20 | XX | |
| Total | [r]169,727 | [4]187,465 | |

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[e] Estimated. [r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] Crushed and dimension stone was produced; data not available by county. Total State values are shown separately under "Stone."

[2] Construction sand was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Washington business activity

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Employment and labor force, annual average: | | | |
| Population thousands | 4,276 | 4,302 | 4,349 |
| Total civilian labor force do | 2,024 | 2,068 | 2,054 |
| Unemployment do | 245 | 231 | 194 |
| Employment (nonagricultural): | | | |
| Mining total[1] do | 3.0 | 2.7 | 2.6 |
| Motal mining[2] do | .7 | .5 | NA |
| Nonmetallic minerals except fuels[2] do | 1.3 | 1.2 | NA |
| Coal mining[2] do | .7 | .7 | NA |
| Oil and gas extraction[2] do | .2 | .2 | NA |
| Manufacturing total do | 289.0 | 277.9 | 284.8 |
| Primary metal industries[2] do | 14.0 | 12.8 | NA |
| Stone, clay, and glass products do | 6.0 | 6.0 | 6.4 |
| Chemicals and allied products do | 9.5 | 10.0 | 10.5 |
| Petroleum and coal products do | 1.8 | 1.8 | NA |
| Construction do | 76.2 | 73.6 | 76.6 |
| Transportation and public utilities do | 89.0 | 87.7 | 90.1 |
| Wholesale and retail trade do | 385.4 | 392.4 | 403.1 |
| Finance, insurance, real estate do | 90.7 | 92.0 | 94.5 |
| Services do | 316.9 | 331.7 | 349.6 |
| Government and government enterprises do | 318.5 | 327.0 | 339.0 |
| Total[3] do | 1,568.6 | 1,585.1 | 1,640.4 |
| Personal income: | | | |
| Total millions | $49,862 | $52,097 | $55,633 |
| Per capita | $11,660 | $12,110 | $12,792 |
| Hours and earnings: | | | |
| Total average weekly hours, production workers | 38.5 | 38.9 | NA |
| Total average hourly earnings, production workers | $11.23 | $11.41 | NA |
| Earnings by industry: | | | |
| Farm income millions | $1,056 | $1,153 | $1,246 |
| Nonfarm do | $33,543 | $34,827 | $37,003 |
| Mining total do | $78 | $74 | $77 |
| Metal mining do | $9 | $8 | $6 |
| Nonmetallic minerals except fuels do | $34 | $32 | $36 |
| Coal mining do | $25 | $27 | $29 |
| Oil and gas extraction do | $11 | $8 | $6 |
| Manufacturing total do | $8,080 | $7,995 | $8,603 |
| Primary metal industries do | $477 | $468 | $501 |
| Stone, clay, and glass products do | $154 | $161 | $172 |
| Chemicals and allied products do | $271 | $320 | $351 |
| Petroleum and coal products do | $81 | $85 | $87 |
| Construction do | $2,204 | $2,089 | $2,124 |
| Transportation and public utilities do | $2,538 | $2,689 | $2,829 |
| Wholesale and retail trade do | $5,923 | $6,169 | $6,443 |
| Finance, insurance, real estate do | $1,756 | $1,940 | $2,067 |
| Services do | $5,769 | $6,170 | $6,641 |
| Government and government enterprises do | $6,938 | $7,411 | $7,919 |
| Construction activity: | | | |
| Number of private and public residential units authorized | 17,891 | 27,481 | 30,526 |
| Value of nonresidential construction millions | $1,186.0 | $1,027.3 | $1,264.0 |
| Value of State road contract awards do | $275.0 | $122.0 | $212.0 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 1,022 | 1,083 | 1,163 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $169.7 | $187.5 | $202.6 |
| Value per capita | $40 | $44 | $47 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

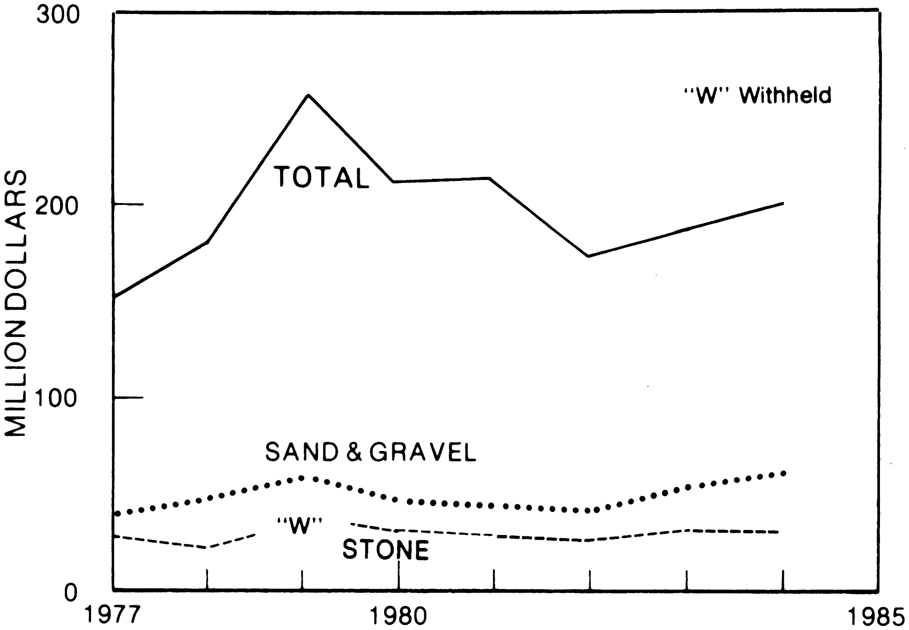

**Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Washington.**

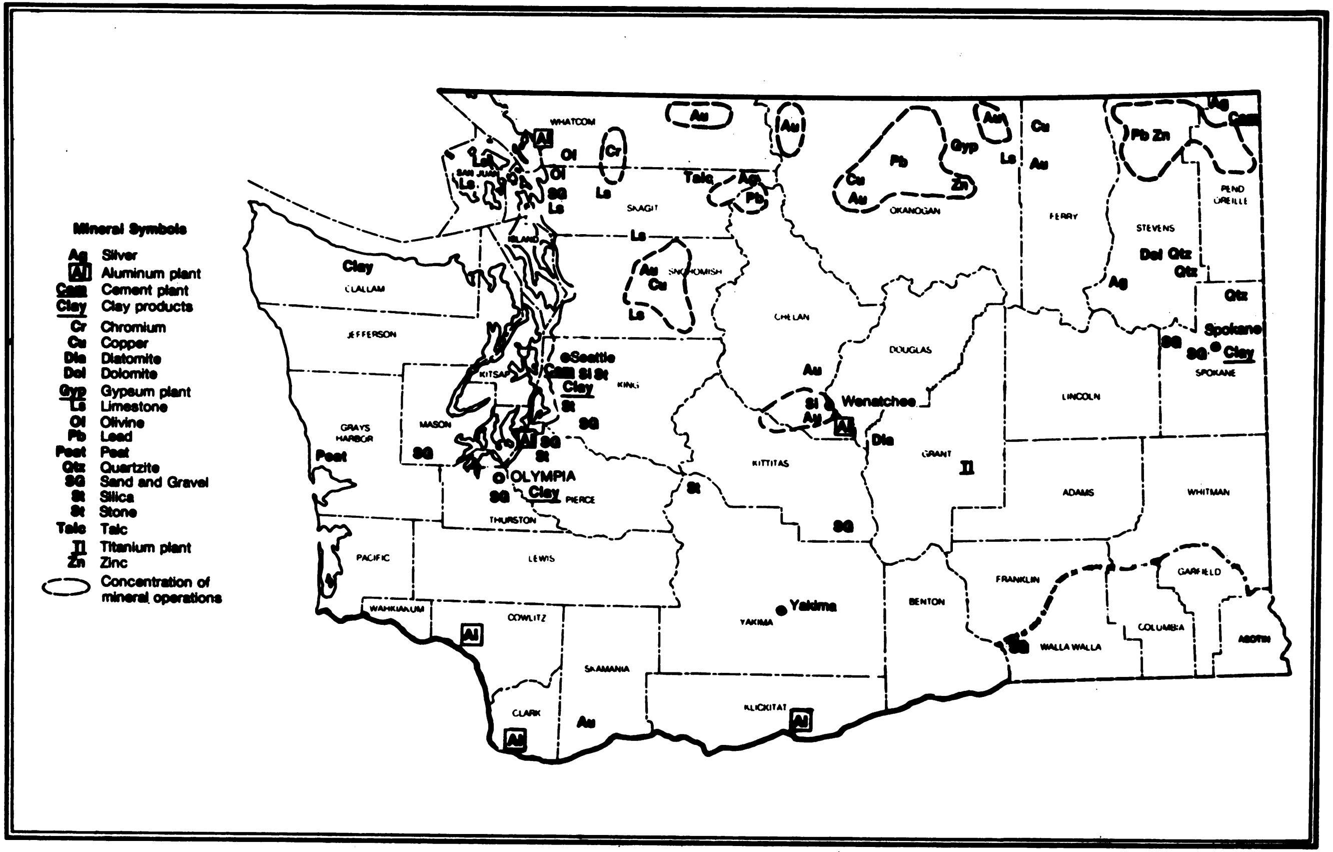

Figure 2.—Principal mineral producing localities in Washington.

**Trends and Developments.**—Improving markets encouraged economic growth in the State in 1984, although recovery got off to a slow start, and the expansion at yearend was less rapid than that for the Nation as a whole. Seasonally adjusted wage and salary employment increased steadily throughout 1984, achieving an overall gain of 3% over that of 1983.

The total reported private investment in exploration and development of Washington's metallic mineral resources for 1984 reached nearly $33 million, more than double the $13.6 million recorded for 1983. Preproduction development of the Cannon Mine in Wenatchee by the Asamera Minerals (U.S.) Inc.-Breakwater Resources Ltd. joint venture contributed $28.5 million to that total. Private expenditures reported for exploring and developing industrial mineral commodities, however, dropped to about $386,000 from the more than $1 million credited for 1983.

**Exploration Activities.**—Exploration in Washington for 1984, largely for precious metal deposits, exceeded the high level of activity established in 1983. Reported expenditures for exploration increased to almost $4.5 million, exceeding the 1983 figure by $900,000. Nearly 75% of the 1984 total was expended in exploration for gold and silver deposits. The number of exploration permits and mining contracts granted by the State increased by 16 to 1,174 in 1984. A total of 96 firms explored 102 metallic mineral projects; most of the 1984 activity was concentrated in the Okanogan Highlands in Stevens, Ferry, Pend Oreille, and Okanogan Counties, while most of the exploration for gold deposits centered in Chelan County.

The Asamera-Breakwater joint venture expanded gold exploration efforts to other areas in the Wenatchee District, Chelan County. The partners now control more than 4,000 acres in the Wenatchee area, with the option of acquiring a majority interest in properties controlled by Ican Resources, Lincoln Resources, Seagold Ltd., and Goldbelt Mines Inc.

United Mining Corp., which controls the old Golden King (Lovitt) Mine and a 9-acre parcel within the B-Reef ore zone adjoining Asamera's Cannon Mine, reached an agreement with Tenneco Minerals Co. to explore its Wenatchee area properties. Subsequent drilling by Tenneco in the B-Reef intersected economic gold mineralization in a minable thickness.

Templar Mining Co., whose 554-acre Wenatchee District holding adjoins Asamera-Breakwater ground on the west and north, announced encouraging results from drilling on its property. A total of 24 mining companies performed exploration in the Wenatchee area and in the Liberty and Blewett Districts in Chelan County.

Sundance Mining-Development Inc. outlined two minable gold-silver ore bodies at its Gold Hill property near Curlew, Ferry County; production was expected to begin in 1985. Elsewhere in Ferry County, Azure Resources Ltd. drilled and sampled gold- and copper-bearing zones on the Lone Star property, Canorex International Inc. explored several properties, and general reconnaissance work was reported by Callahan Mining Corp., Freeport Exploration Co., and Gold Fields Mining Corp.

St. Joe American Corp. reported geological and geochemical exploration for gold on its Star claims in Chelan and Kittitas Counties. Nord Resources Corp. and Gold Fields Mining carried out reconnaissance exploration in Kittitas County during the year.

In Lincoln County, Rexcon Inc. explored its Junction Reef gold prospect with geophysical surveys and shallow drilling.

Crown Resources Corp. drilled the Key property in Okanogan County for precious metals in gold-bearing magnetite and also explored the Bodie Mine area.

Wilbur Hallauer did exploration drilling on the Star molybdenum property for tungsten, on the Kelsey property to determine the precious metal potential of copper-bearing ores, and on the Copper World Extension as a followup to precious metal exploration done in 1983. Keystone Gold Inc. explored the Crystal Butte and Grey Eagle properties with detailed geochemical and geological studies. Callahan Mining and Gold Fields Mining reported doing reconnaissance work in Okanogan County.

Pintlar Corp. kept the Pend Oreille Mine in Metaline Falls, Pend Oreille County, on maintenance status and carried out exploration and development work at the mine. Terra Alta Mining Co. explored at the La Sota lead-zinc property, and Canorex International worked on several properties in Pend Oreille County. Shell Mining Co. drilled the First Thought Mine near Orient in Stevens County during 1984. Mines Management Inc. drilled on the Big Iron property for potential gold values and also did trenching on the Advance property and underground rehabilitation on the Iroquois workings. Getty Mining Co. drilled at the Bonanza Mine, and Canorex explored for precious and base metals at several properties in Stevens County. Other companies reporting exploration activity in Stevens County during the year were Huckleberry Mountain Ltd., Northwest Minerals Development Corp., Vanhorn and Watson Mining Co., Leadpoint Consolidated Mines Co., Arbor Resources Inc., Terra Alta, Callahan Mining, Boise Cascade Corp., Exploration Ventures Co., and Freeport Exploration.

Underground sampling was done at the New Light Mine, and exploration was carried out at the Minnesota Mine; both mines are in the Slate Creek District, Whatcom County.

**Legislation and Government Programs.**—The regular 1984 session of the 48th Legislature enacted three measures affecting mining; these were duly signed into law by the Governor: (1) a supplementary act related to the Clean Air Act provided civil penalties of a fine up to $1,000, imprisonment, or both, for each infraction of the act—this law could impact all the State's primary metal smelters; (2) a modification to the Surface Mining Act provided for reclamation of surface-mined land under a plan approved by the State Department of Natural Resources; and (3) an act provided for the extinguishment of mineral interest on real property by the surface owner, if the mineral interest is unused for a period of 20 years.

In January, a cooperative agreement was signed between the Federal Office of Surface Mining (OSM) and the Washington Division of Geology and Earth Resources (DGER) to conduct an inventory of all abandoned coal mine lands within the State. The study will lead to eventual OSM corrective action on sites deemed to affect the health, safety, and general welfare of the public.

Washington received $434,656 in 1984 from the Bureau of Land Management (BLM) as receipts from the Mineral Leasing Act.

The Mining and Mineral Resources and Research Institute at the University of Washington in Seattle received a grant from the U.S. Bureau of Mines in 1984. Part was used as seed money to develop programs for major projects with other agencies, and part was used for research fellowships.

The State DGER published a joint State-U.S. Bureau of Mines report entitled, "Availability of Federal Land for Mineral Exploration in the State of Washington," issued as Geologic Map GM-30.

Geologic mapping by DGER was continued in the Columbia Basin with funds supplied by the U.S. Department of Energy; the division expects to release at least five 1:48,000 scale geologic quadrangle maps during 1985. The State geologic map project is on schedule. As part of the program, the State financed 14 graduate student mapping projects across the State, and a cooperative mapping program with the U.S. Geological Survey in the Mount St. Helens area.

The Washington wilderness bill, which set aside 1.07 million acres of natural land in the State, was signed by the President on July 3. The measure increased Washington's inventory of wilderness lands to about 2.5 million acres.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Barite.**—Three companies, Boise Cascade, Canorex International, and Cominco American Incorporated, reported exploration for barite in northeastern Washington in 1984. C-E Minerals, a wholly owned subsidiary of Combustion Engineering Inc., shipped barite flotation concentrates from its mill at Leadpoint in northern Stevens County.

**Calcium Chloride.**—The quantity of calcium chloride produced in Washington in 1984 was double that of 1983, while the value rose 48%. Two companies in Tacoma, Pierce County, produced calcium chloride. Reichold Chemicals Inc. recovered synthetic calcium chloride as a byproduct from organic chemical production, and Occidental Chemical Corp. manufactured calcium chloride using limestone and hydrochloric acid.

**Cement.**—Portland cement was produced by four companies in King, Pend Oreille, and Whatcom Counties: Ideal Basic Industries Inc. and Ash Grove Cement West Inc., Seattle; Lehigh Portland Cement Co., Metaline Falls; and Columbia Cement Corp., Bellingham. Ash Grove, Lehigh, and Columbia Cement also produced masonry cement. Portland cement was used by ready-mixed concrete companies (84%); concrete product manufacturers (8%), and others, including building material dealers, highway contractors, other contractors, and miscellaneous customers (8%). All four plants used coal and electricity for fuel and energy; two plants also used natural gas. Raw materials used in cement production were limestone, clay, sand, quartzite, iron ore, aluminum dross, fly ash, and gypsum.

The Lone Star Industries cement plant in Seattle was purchased in March by Ash Grove Cement Co. of Kansas; the new operating company is Ash Grove Cement West.

**Clays.**—Clay production in 1984 increased 4% in quantity but decreased 4% in value from that reported for 1983. Clay was produced by four companies from nine pits in five counties. Nearly 80% of the State's production came from Clallam and King Counties; fire clay was also produced in King County. About 95% of the clay produced was used for common brick, face brick, or in portland cement.

**Diatomite.**—Washington's 1984 diatomite production increased 5% in quantity and 7% in value over that reported for 1983. Witco Chemical Corp.-Inorganic Specialties Div., the State's only diatomite producer, processed diatomite at its Quincy plant in Grant County.

**Feldspar.**—W. R. Matthews, of Matthews Scientific Foundation, reported continued research in 1984 related to the quartz-mica-feldspar potential of the Feldslite property near Lake Wenatchee in Chelan County. In 1984, 1 ton of material was mined for testing purposes.

**Gypsum.**—Crude gypsum was mined by Agro Minerals Inc. from the State's only gypsum mine at Poison Lake, Okanogan County. Agro Minerals has been mining gypsite from the Poison Lake deposit since 1948; the granulated gypsum product was used primarily as a soil conditioner. Calcined gypsum was produced by Norwest Gypsum Inc. in Seattle and by Domtar Gypsum America Inc. at Tacoma in Pierce County.

**Lime.**—Quicklime was produced by Northwest Alloys Inc. near Addy in Stevens County; Tacoma Lime, a division of Continental Lime Inc., produced quicklime and hydrated lime at its Tacoma plant in Pierce County. Both production and value were higher than that reported for 1983.

**Olivine.**—IMC Olivine produced olivine from stockpiled inventory mined from the Twin Sisters deposit at Hamilton in Skagit County.

**Peat.**—Washington's peat production for 1984 was down slightly from that of 1983. Four companies—Maple Valley Humus in King County, Chester L. Asbury in Kitsap County, Bonaparte Peat in Okanogan County, and Zycom Inc. in Pierce County—reported production of peat during 1984.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Washington's 1984 output of construction sand and gravel increased more than 54% in quantity and nearly 52% in value over that reported for 1982, when the last complete canvass was taken. The State ranked 10th in the Nation in construction sand and gravel production for 1984. Of 39 counties, 31 reported production, with King, Pierce, Snohomish, and Spokane accounting for about 56% of the total production value. Major uses were for concrete aggregate (22%), road base and coverings (15%), fill (14%), and other (34%). Nearly 70% of the construction sand and gravel produced was transported by truck.

Lone Star Industries sold its sand and gravel facilities at Steilacoom and Maury Island in Puget Sound to Reidel International Inc. of Portland, OR. The facilities were renamed Pioneer Construction Materials Co. by Reidel.

*Industrial.*—Industrial sand production in Washington increased 16% in volume and 23% in value from that recorded for 1983. Production was reported by four operations in Chelan, King, and Stevens Counties; primary uses were for glass containers, ferrosilicon, sand blasting sand, fluxes, filtration, cement manufacture, and in other applications.

**Table 4.—Washington: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 5,059 | $14,563 | $2.88 |
| Plaster and gunite sands | 329 | 696 | 2.12 |
| Concrete products | 144 | 499 | 3.47 |
| Asphaltic concrete | 2,226 | 7,012 | 3.15 |
| Road base and coverings[1] | 3,499 | 9,568 | 2.73 |
| Fill | 3,341 | 5,819 | 1.74 |
| Snow and ice control | 233 | 501 | 2.15 |
| Railroad ballast | 634 | 2,125 | 3.35 |
| Other[2] | 7,905 | 20,288 | 2.57 |
| Total[3] or average | 23,369 | 61,070 | 2.61 |

[1] Includes road and other stabilization (cement and lime).
[2] Includes other unspecified uses.
[3] Data may not add to totals shown because of independent rounding.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

The quantity of crushed stone production for 1984 in Washington was estimated to nearly equal that reported for 1983, and the estimated value increased 7% over that for 1983.

Northwest Alloys Inc. quarried dolomite and quartzite near Addy, in Stevens County, for use in magnesium metal production. Nanome Aggregates Inc. produced dolomite for terrazzo and decorative stone from 15 quarries in Stevens County.

**Sulfur (Recovered).**—Sulfur was produced as a byproduct from petroleum refining, in Whatcom County by Atlantic Richfield Co. at Cherry Point, and by Mobil Oil Corp. at Ferndale.

**Talc.**—Cascade Talc Inc. produced talc from its Cascade pit in Skagit County. All of the talc sold was used in insecticides.

## METALS

**Aluminum.**—Washington again ranked first in the Nation in quantity and value of primary aluminum produced in the State in 1984, with more than 1 million metric tons valued in excess of $2 billion. The State's seven reduction plants accounted for an estimated 27% of all 1984 aluminum production in the United States. Reflecting the mid-1983 economic recovery, Washington's aluminum smelters were operating at nearly full capacity in early 1984, with the exception of Kaiser Aluminum & Chemical Corp.'s Mead plant. A worldwide aluminum oversupply, however, led to a 68% drop in aluminum prices by midyear. This factor, together with increased power rates, led to partial shutdowns at Kaiser's Mead facility, the Aluminum Co. of America's (Alcoa) Vancouver smelter, and Alumax Inc.'s Ferndale plant, leaving State production at 90% of capacity at yearend.

In September, the Northwest aluminum companies signed contracts with the Bonneville Power Administration for an incentive power rate of 2.27 cents per kilowatt hour (a drop of 0.5 cents) for 6 months.

In October, Martin Marietta Corp. announced the sale of its 185,000-ton-per-year Goldendale smelter to Comalco Pty. Ltd., Australia.

Alcoa invested $19.2 million in 1984 to rebuild three anode baking furnaces and purchase ancillary equipment at its aluminum plant south of Wenatchee. Construction started in July, with a planned completion date in late 1985. Alcoa also continued construction on a $40 million pollution control system that was estimated to be 80% complete by yearend.

**Table 5.—Washington: Primary aluminum plant production data**

| Year | Quantity (thousand short tons) | Percent of national total | Value (thousands) |
|---|---|---|---|
| 1980 | 1,171 | 23 | $1,678,645 |
| 1981 | 1,209 | 24 | 1,837,630 |
| 1982 | 967 | 27 | 1,470,074 |
| 1983 | 1,081 | 29 | 1,682,233 |
| 1984[e] | 1,241 | 27 | 2,010,971 |

[e] Estimated.

**Copper.**—ASARCO Incorporated announced in June that its Tacoma copper smelter, the only domestic smelter processing high-arsenic concentrates, would close permanently in 1985. The company planned to continue production of arsenic trioxide, but about 500 permanent jobs would be lost to the State's economy. Reasons cited for the closure were the high cost of complying with the Environmental Protection Agency's arsenic emission standards, low copper prices, and unavailability of suitable copper concentrates.

**Gold.**—Gold production was recorded for Hecla Mining Co.'s Knob Hill Mine at Republic, in Ferry County. A 1983 announcement that the mine's ore reserves would be exhausted by mid-1984 was reversed in June, when Hecla announced discovery of new reserves sufficient to enable preduction to continue for at least 2 additional years. Gold production from the Knob Hill Mine for 1984 increased 100% in quantity and 73% in value over that reported for 1983.

Hecla also milled ores from Crown Resources Corp.'s Seattle Mine, in the Republic District. Cordilleran Development Inc. began open pit mining and heap-leach testing on 10,000 tons of gold-silver ore at the Minnie Mine property near Carlton, Okanogan County. Heap leaching of gold and silver ore was continued at the Gold Dike Mine near Danville, in Ferry County, by Vulcan Mountain Inc.

The Asamera-Breakwater joint venture continued development work at its $50 million Cannon Mine at Wenatchee, Chelan County. Underground development of the B-Reef ore bodies was well under way by yearend, with completion of an 18-foot-diameter, 620-foot-deep shaft, approximately 6,000 feet of decline, and three production access drifts into the ore body. Completion of the 2,000-ton-per-day concentrator, tailings impoundment, and mine development were targeted for mid-1985, with full-scale production set for the third quarter of 1985.

**Lead.**—In July, Bergsoe Metal Corp. of St. Helens, OR, sold its 33,000-metric-ton-per-year-capacity secondary smelter-refinery and lead products complex at Seattle to Seafab Metal Corp., a newly formed company. Seafab permanently closed the smelter-refinery, reducing the secondary lead production capacity in the Pacific Northwest by more than 50%. However, the lead products production facilities remained open.

**Magnesium.**—Northwest Alloys, a wholly owned subsidiary of Alcoa, operated its magnesium metal plant at Addy in Stevens County at capacity during the year. Because of increased demand, Northwest Alloys announced the start of construction of a 10th furnace during the 3d quarter. The company produced magnesium metal from locally mined dolomite, employing a silicothermic process using in-plant manufactured ferrosilicon and aluminum-quartzite flux. Most of the plant production was used by Alcoa as an alloying agent for aluminum.

**Silicon.**—Union Carbide Corp. started up the first of 48 reactors at its new polycrystalline silicon plant at Moses Lake in Grant County. All 48 reactors were scheduled to be in use by mid-1985; plant output was expected to be about 1,300 short tons per year. Citing an extreme demand for its product, Union Carbide announced plans for a 40% to 70% increase in plant capacity and further announced tentative plans for the construction of a larger second plant. The proposed new plant, still in the design stage, would cost $200 million and would have an annual output of about 3,300 short tons of silicon.

In August 1984, The Hanna Mining Co. marked the 10th anniversary of production at its Rock Island silicon and ferrosilicon plant near Wenatchee. After a 7-month closure due to adverse economic conditions, ending in May 1983, the plant set new production records in 1984. Most of the plant output went to the aluminum, steel, and electronics industries; the Union Carbide polycrystalline silica plant at Moses Lake will use premium-grade silica supplied by Hanna.

**Silver.**—Hecla was the State's only silver producer in 1984. The company recovered byproduct silver from the Knob Hill Mine at Republic, in Ferry County. The 1984 production increased in quantity but declined in value from that reported for 1983.

Although Madre Mining Ltd. announced in mid-June that its Deer Trail Mine near Fruitland, in Stevens County, had blocked out enough ore to place the mill on a 24-hour basis, they suspended operations in late July, citing depressed silver prices. Kaaba Resources Inc. rehabilitated some of the old Ruby Silver Mine workings in Okanogan County and carried out general exploration on the property.

**Titanium.**—International Titanium Inc. reduced production in October at its 2,500-short-ton-per-year titanium sponge plant at Moses Lake. Reasons cited for the cutback were environmental constraints imposed by the State Department of Ecology that required the company to recycle and dispose of an accumulation of purification filter residue, and general market conditions.

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[1] State Mineral Officer, Bureau of Mines, Spokane, WA.

[2] Geologist, Washington Division of Geology and Earth Resources, Olympia, WA.

## Table 6.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum: | | | |
| Aluminum Co. of America | Box 120<br>Vancouver, WA 98660 | Plant | Clark. |
| Do | Box 221<br>Wenatchee, WA 98801 | do | Chelan. |
| Comalco Pty. Ltd | 95 Collins St.<br>Melbourne, Victoria 3000<br>Australia | do | Klickitat. |
| Intalco Aluminum Corp | Box 937<br>Ferndale, WA 98248 | do | Whatcom. |
| Kaiser Aluminum & Chemical Corp. | Box 6217<br>Spokane, WA 99207 | do | Spokane. |
| Do | 3400 Taylor Way<br>Tacoma, WA 98421 | do | Pierce. |
| Reynolds Metals Co | Box 999<br>Longview, WA 98632 | do | Cowlitz. |
| Cement: | | | |
| Ash Grove Cement West Inc | Box 1020<br>Seattle, WA 98111 | do | King. |
| Columbia Cement Corp., a subsidiary of Ashland Technology Inc. | Box 37, Marietta Rd.<br>Bollingham, WA 98225 | do | Whatcom. |
| Ideal Basic Industries Inc | Box 8789<br>Denver, CO 80201 | do | King. |
| Lehigh Portland Cement Co | 718 Hamilton Mall<br>Box 1882<br>Allentown, PA 18105 | do | Pend Oreille. |
| Clays: | | | |
| Ideal Basic Industries Inc | Box 8789<br>Denver, CO 80201 | Pit | Clallam. |
| Mutual Materials Co | Box 2009<br>Bellevue, WA 98009 | Pits and plant | King and Pierce. |
| North American Refractories, Western Div., Allied Chemical Co. | Box 120<br>Renton, WA 98057 | do | King. |
| Diatomite: | | | |
| Inorganic Specialties, a division of Witco Chemical Corp. | 520 Madison Ave.<br>New York, NY 10072 | Mine and plant | Grant. |
| Gold: | | | |
| Hecla Mining Co | Hecla Building<br>Wallace, ID 83873 | Mine and mill | Ferry. |
| Lime: | | | |
| Northwest Alloys Inc.[1] | Box 138A, Route 1<br>Addy, WA 99101 | Plant and mine | Stevens. |
| Tacoma Lime, a division of Continental Lime Inc. | 1220 Alexander Ave.<br>Tacoma, WA 98421 | Plant | Pierce. |
| Peat: | | | |
| Bonaparte Peat | Aeneas Route, Box 5<br>Tonasket, WA 98855 | Bog | Okanogan. |
| Maple Valley Humus | 18805 SE. 170th St.<br>Renton, WA 98055 | Bog | King. |
| Sand and gravel: | | | |
| Construction: | | | |
| Associated Sand & Gravel Co. Inc. | Box 2037<br>Everett, WA 98203 | Pits | Skagit and Snohomish. |
| Cadman Gravel Co | Box 538<br>Redmond, WA 98052 | Pit | King. |
| Central Pre-Mix Concrete Co | East 5111 Broadway<br>Spokane, WA 99206 | Pits | Various. |
| Glacier Sand & Gravel Co | 5975 East Marginal Way South<br>Seattle, WA 98134 | Pit | Pierce. |
| Lafarge Concrete Ltd. (Friday Harbor Sand & Gravel Co.) | Box 1203<br>Bellingham, WA 98225 | Pit | San Juan. |
| Lakeside Sand & Gravel Co. Inc. | Box 46<br>Issaquah, WA 98027 | Pit | King. |
| Miles Sand & Gravel Co | Box 130<br>Auburn, WA 98002 | Pits | King and Kitsap. |
| Pioneer Construction Materials Co. | 901 Fairview Ave. North<br>Seattle, WA 98111 | Pit | Pierce. |
| Industrial: | | | |
| Industrial Mineral Products Inc. | Box 95<br>Ravensdale, WA 98051 | Quarry and plant | King. |
| Lane Mountain Silica Co | Box 236<br>Valley, WA 99181 | do | Stevens. |
| Wenatchee Silica Products Inc. | 610 Doneen Bldg., Box 1668<br>Wenatchee, WA 98801 | Quarry | Chelan. |
| Titanium: | | | |
| International Titanium Inc | 1320 Wheeler Rd.<br>Moses Lake, WA 98837 | Sponge metal plant. | Grant. |

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[1] Also magnesium.

# The Mineral Industry of West Virginia

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the West Virginia Geological and Economic Survey for collecting information on all nonfuel minerals.**

**By Donald K. Harrison[1] and Dewey S. Kirstein[2]**

The value of West Virginia's nonfuel mineral production in 1984 was $112.2 million, an $8.2 million increase over that of 1983. Crushed stone was the leading commodity produced accounting for nearly one-third of the State's total nonfuel mineral value. Other major commodities produced included cement, common clay and shale, fire clay, construction sand and gravel, industrial sand, and salt. Mineral commodities processed or manufactured but not included on the State's total nonfuel mineral value on table 1 included aluminum, ferroalloys, fluorspar, synthetic graphite, finished iron oxide pigments, iron and steel, nickel, iron and steel slag, zinc, and zirconium.

Nationally, West Virginia ranked 38th in the value of nonfuel minerals produced. The State ranked second in ferroalloy shipments, third in finished iron oxide pigments shipments, and fourth in fire clay production.

**Table 1.—Nonfuel mineral production in West Virginia[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | [2]249 | [2]$532 | 381 | $3,410 |
| Salt do | 1,026 | W | 1,004 | W |
| Sand and gravel (construction) do | [e]700 | [e]3,400 | 976 | 3,198 |
| Stone (crushed) do | 9,439 | 37,962 | [e]9,100 | [e]37,300 |
| Combined value of cement, clays (fire clay, 1983), lime, sand and gravel (industrial), and values indicated by symbol W | XX | 62,079 | XX | 68,279 |
| Total | XX | 103,973 | XX | 112,187 |

[e] Estimated. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay; value included with "Combined value" figure.

## Table 2.—Value of nonfuel mineral production in West Virginia, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Berkeley | $24,612 | W | Cement, stone (crushed), clays. |
| Fayette | -- | W | Stone (crushed). |
| Grant | W | $1,104 | Do. |
| Greenbrier | (2) | 6,198 | Do. |
| Hampshire | (2) | W | Do. |
| Hancock | W | W | Clays. |
| Harrison | (2) | W | Stone (crushed). |
| Jackson | (2) | 1 | Do. |
| Jefferson | (2) | W | Do. |
| Kanawha | (2) | W | Do. |
| Lincoln | W | W | Clays. |
| Logan | (2) | 544 | Stone (crushed). |
| Marshall | W | 10,556 | Salt and stone (crushed). |
| Mason | 92 | (3) | |
| Mercer | (2) | W | Stone (crushed). |
| Mineral | (2) | 884 | Do. |
| Monongalia | (2) | W | Do. |
| Morgan | W | W | Sand (industrial). |
| Pendleton | W | W | Stone (crushed), lime. |
| Pocahontas | (2) | 159 | Stone (crushed). |
| Preston | (2) | W | Do. |
| Raleigh | (2) | W | Do. |
| Randolph | (2) | 4,426 | Do. |
| Tucker | (2) | 1,251 | Do. |
| Tyler | W | W | Salt. |
| Wetzel | W | (3) | |
| Wyoming | W | W | Stone (crushed), sand (industrial). |
| Undistributed | 28,217 | 75,450 | |
| Sand and gravel (construction) | XX | [e]3,400 | |
| Stone (crushed) | [e]22,700 | XX | |
| Total | [4]75,620 | 103,973 | |

[e] Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Crushed stone was produced; data not available by county. Total State value is shown separately under "Stone (crushed)."

[3] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[4] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of West Virginia business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 1,961 | 1,962 | 1,952 |
| Total civilian labor force | do. | 775 | 771 | 769 |
| Unemployment | do. | 108 | 139 | 116 |
| Employment (nonagricultural): | | | | |
| Mining total | do. | 63.5 | 48.6 | 48.4 |
| Nonmetallic minerals except fuels[1] | do. | 1.1 | .9 | 1.0 |
| Coal mining | do. | 56.3 | 41.8 | 41.3 |
| Oil and gas extraction | do. | 6.1 | 5.9 | 6.1 |
| Manufacturing total | do. | 98.1 | 89.8 | 91.1 |
| Primary metal industries | do. | 16.5 | 14.4 | 15.6 |
| Stone, clay, and glass products | do. | 11.3 | 10.4 | 10.2 |
| Chemicals and allied products | do. | 23.0 | 21.6 | 20.5 |
| Petroleum and coal products[1] | do. | .8 | .7 | NA |
| Construction | do. | 24.4 | 21.6 | 22.3 |
| Transportation and public utilities | do. | 41.7 | 39.4 | 39.5 |
| Wholesale and retail trade | do. | 127.9 | 127.4 | 131.2 |
| Finance, insurance, real estate | do. | 22.1 | 22.2 | 23.2 |
| Services | do. | 103.4 | 105.5 | 107.7 |
| Government and government enterprises | do. | 126.8 | 127.8 | 131.6 |
| Total | do. | [2]607.8 | 582.3 | 595.0 |
| Personal income: | | | | |
| Total | millions | $17,535 | $17,876 | $18,991 |
| Per capita | | $8,943 | $9,110 | $9,728 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 38.8 | 39.6 | 40.3 |
| Mining | | 39.7 | 40.9 | 40.7 |
| Total average hourly earnings, production workers | | $9.40 | $9.74 | $9.93 |
| Mining | | $13.24 | $14.32 | $15.41 |

See footnotes at end of table.

**Table 3.—Indicators of West Virginia business activity —Continued**

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Earnings by industry: | | | | |
| Farm income | millions | $4 | $9 | $17 |
| Nonfarm | do | $12,050 | $11,830 | $12,696 |
| Mining total | do | $2,186 | $1,730 | $1,902 |
| Nonmetallic minerals except fuels | do | $20 | $20 | $22 |
| Coal mining | do | $1,916 | $1,524 | $1,672 |
| Oil and gas extraction | do | $250 | $186 | $207 |
| Manufacturing total | do | $2,480 | $2,365 | $2,513 |
| Primary metal industries | do | $615 | $557 | $580 |
| Stone, clay, and glass products | do | $236 | $230 | $241 |
| Chemicals and allied products | do | $753 | $755 | $780 |
| Petroleum and coal products | do | $30 | $24 | $25 |
| Construction | do | $562 | $542 | $572 |
| Transportation and public utilities | do | $1,111 | $1,145 | $1,226 |
| Wholesale and retail trade | do | $1,666 | $1,716 | $1,834 |
| Finance, insurance, real estate | do | $398 | $437 | $477 |
| Services | do | $1,735 | $1,918 | $2,075 |
| Government and government enterprises | do | $1,888 | $1,953 | $2,070 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 1,824 | 1,834 | 2,001 |
| Value of nonresidential construction | millions | $1,465 | $141.3 | $123.2 |
| Value of State road contract awards | do | $244.0 | $325.0 | $290.0 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 487 | 473 | 474 |
| Nonfuel mineral production value: | | | | |
| Total crude mineral value | millions | $75.6 | $104.0 | $112.2 |
| Value per capita | | $39 | $53 | $57 |

[p]Preliminary. [r]Revised. NA Not available.

[1] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[2] Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

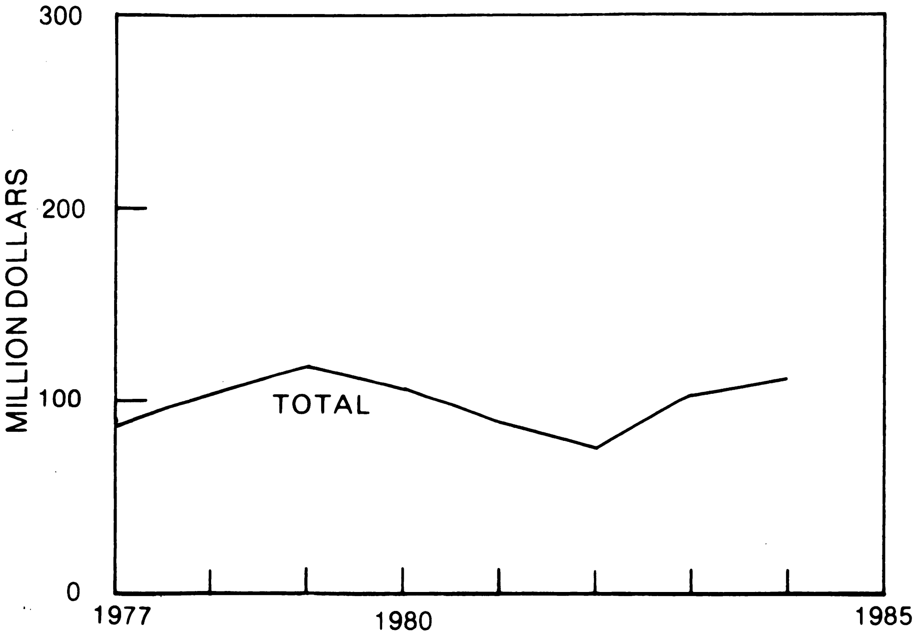

Figure 1.—Total value of nonfuel mineral production in West Virginia.

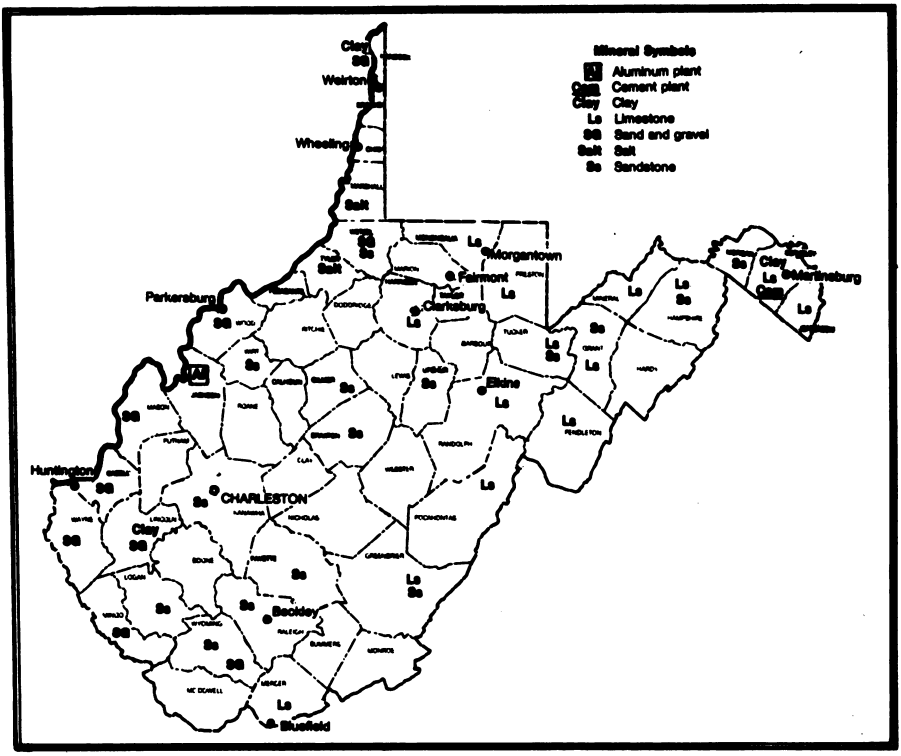

Figure 2.—Principal mineral producing localities in West Virginia.

**Trends and Developments.**—Several mining firms and mineral processors announced expansion plans or new startups during the year. Pennsylvania Glass Sand Corp. announced in July that it was planning to modernize and expand its ground silica lines at Berkeley Springs, and Greer Limestone Co. was planning to install an underground crushing facility at its main stone quarry at Greer. In the steel sector, both Weirton Steel Corp., Weirton, and Steel of West Virginia Inc., Huntington, announced multimillion-dollar renovations at their mills.

Anticipating an increase in demand for their products, at least two mineral processors announced the startup of new facilities at their operations. In May, PPG Industries Inc. brought on-stream a modernized, energy-efficient chlorine and caustic soda production circuit at its Natrium chemical plant, and Inco Alloys International Inc. started operating a $2 million, 15-ton, vacuum induction melting (VIM) furnace at its Huntington plant in late August.

Exports of mineral commodities mined or processed in the State continued to be important to the State's economy. West Virginia's leading manufactured export was chemicals, which accounted for more than one-half of the State's foreign sales. Primary metals, petroleum, coal, stone, clay, and glass products were other major manufactured exports. The State was the country's leading exporter of bituminous coal accounting for nearly one-half of U.S. foreign coal sales. West Virginia was also a major U.S. exporter of ferrosilicon and ranked 10th nationally as an exporter of primary metal products.

**Legislation and Government Programs.**—Several West Virginia laws relating to the mineral industry were enacted in 1984. House bill 1206, passed in March, continued and reestablished the U.S. Geological Survey program within the Department of Natural Resources until July 1, 1990. The bill went into effect 90 days after its passage.

Two Senate bills were also signed into law in March. Senate bill 698 amended and revised chapter 20 of the West Virginia Coal Mining and Reclamation Act. The law prohibits surface mining without a permit and establishes permitting requirements for those wishing to engage in the mining, production, and transportation of minerals. Senate bill 256 continued and reestablished the oil and gas board within the Department of Mines. The bill also increased the limit on salaries for the supervisory inspector and inspectors in the Office of Oil and Gas.

The Economic Section of the West Virginia Geological and Economic Survey (WVGES) is responsible for compiling statistics on West Virginia's mineral extraction and processing industries and engages in applied research and data accumulation for all nonfuel mineral commodities. One ongoing project during the year was an evaluation of raw materials near West Virginia's high-growth areas. The project was directed toward assessing raw materials needed for masonry, concrete, and concrete products. Samples of sand and gravel, limestone, and lightweight aggregate shale were collected for testing and evaluation. The sand and gravel samples were tested by the West Virginia Department of Highways.

In an effort to evaluate the State's limestone resources and to aid the State's producers, the Economic Section continued assessing the availability and analyses of this resource. A computerized data base of information on the chemical composition and physical properties of limestone samples from West Virginia and adjacent States was maintained and contains analyses performed on nearly 4,000 samples. A literature search review was conducted, and information on nearly 500 sandstone samples from Braxton, Fayette, Kanawha, Raleigh, and Wyoming Counties was obtained in developing a similar data base on West Virginia's sandstones.

The WVGES also updated a State mineral resource map, which it expected to publish in 1985. Reports published during the year concerning mineral resources included an article on construction aggregates in the State; an open file report on the State's dimension stone; a directory of mineral producers and processors; and a report on the status of West Virginia's mineral industry.[3]

During fiscal year 1984, the U.S. Bureau of Mines had 13 active contracts or grants in West Virginia valued at $978,045, the majority of which were with West Virginia University (WVU), Morgantown. One of the larger contracts awarded to WVU was for a study on the incidence and characteristics of back injuries incurred by underground miners while lifting, carrying, or performing other manual tasks in mines.

During the year, the U.S. Bureau of Mines Pittsburgh Research Center and the West Virginia Department of Mines prepared a technical report summarizing data files and access procedures for the West Virginia Safety Information System (SIS), a computer-based collection of general mine and safety information designed for administrative and statutory purposes. Major data files in the SIS included general information on deep mines and surface mines; comprehensive safety programs (statutory requirement in West Virginia); injuries; mine production; electrical examinations; mine rescue teams; mine certification; mine inspections; oil and gas well information; and Educational Materials Search System of the U.S. Department of Labor's Mine Safety and Health Administration.

A new longwall shearer, developed under contract by the U.S. Bureau of Mines, was being tested in a West Virginia mine where overexposure to noise has been a problem. The experimental, low-noise cutting device was being tested by the Consolidation Coal Co. at its Robinson Run Mine at Shinnston.

In July, the U.S. Bureau of Mines made an allotment grant of $150,000 to the Mining and Mineral Resources and Research Institute at WVU, Morgantown. The allotment was part of the Mineral Institute program created under title III of Public Law 95-87. To receive the allotment, the school had to match the Federal funds with $150,000 from non-Federal sources. In 1984, the authorization for the Mineral Institute program, in its seventh year, was extended through fiscal year 1989 after the President signed Public Law 98-409. Additional research grants were also jointly made to WVU and Pennsylvania State University for research on respirable dusts under the Generic Center Research Program.

In fiscal year 1984, several West Virginia counties received a total of $275,032 from the Federal Government as their share of royalties for various activities in Monongahela National Forest. As required by law, 25% of the fiscal year's total 1984 receipts are returned to States where the U.S. Forest Service-administered lands are located. The majority of the monies were attributable to mineral leasing and mining royalties.

# REVIEW BY NONFUEL MINERAL COMMODITIES

## NONMETALS

The State's mineral industry responded to strong demand for commodities used in the construction industry as a result of increased housing starts and contract construction.

**Cement.**—Capital Cement Corp., a subsidiary of Riverton Corp., operated the State's only cement plant at Martinsburg, Berkeley County, in the State's eastern panhandle. The wet-process plant, which produces both portland and masonry cement, operated three coal-fired kilns and has a grinding capacity of 935,000 short tons per year. Shipments and value of portland cement were up 9% and 21%, respectively, over 1983 levels. Masonry cement shipments and value slightly decreased during the same period.

In July, the West Virginia Air Pollution Control Commission cited Capital Cement for violations of State clean air standards. Neighboring communities had complained to Berkeley County commissioners about dust escaping from the plant. Near yearend, Capital Cement submitted a detailed report to the West Virginia Air Pollution Control Commission on its plans to control fugitive emissions from its cement operations.

**Clays.**—In 1984, West Virginia produced both common and fire clays. Common clay was produced by Continental Brick Co. (formerly Continental Clay Products Co.), Capital Cement in Berkeley County, and by Sanders Dummy Co. in Lincoln County. Continental used the clay for the manufacture of face brick while Capital Cement's use was for the manufacture of portland cement. Common clay mined by Sanders was sold for "dummy clay" used by the mining industry for explosive stemming. Production and value of common clay increased 14% and 16%, respectively, compared with that of 1983.

Continental, the sole brick producer in the State, struggled through lengthy chapter 11 bankruptcy proceedings in 1982-83. In March 1984, litigation was settled and the company was purchased by Imperial Coal Sales Co. Inc. (60%), Lynchburg, VA, and four other concerns (40%). Part of Imperial's plan for putting the brick plant back on its feet was a proposed conversion of the company's energy system from natural gas to a coal-fired kiln. In late 1984, State officials announced a tentative $500,000 grant from the Appalachian Regional Commission for the conversion. Continental employed 65 people with the potential of employing an additional 30 if the energy conversion is completed.

Fire clay was mined by one company, Globe Refractories Inc., a subsidiary of Combustion Engineering Inc., Hancock County. Output of fire clay decreased 40%, continuing a trend established by lower levels of steel production. Value increased more than 50% compared with that of 1983. In November, Combustion Engineering considered closing the plant because of the depressed market for its products. The fire clay produced there was used in the manufacture of firebrick and various refractory specialties utilized by the steel industry. Near yearend, the company employed 128 workers; about 113 hourly workers were on layoff.

**Fluorspar.**—Although no fluorspar was produced in West Virginia, 14,480 short tons was consumed by industries in the State. This represented a continuing decline in consumption and a 40% drop compared with 1983 levels because of depressed markets. Fluorspar was used by the ceramic industry as a flux and opacifier in the manufacture of glass products; it was also used as a flux in steelmaking, for hydrofluoric acid, and in other manufacturing processes.

**Gem Stones.**—Several gem stones occur in the State's predominantly sedimentary rocks. Among the mineral specimens found in the State are a type of coral, some opal, several quartz varieties, and two coal or coallike minerals. A report describing one coallike mineral, grahamite, was published during the year.[4] The grahamite vein at the Ritchie Mine, Ritchie County, is an unusual hydrocarbon deposit and is unique in the State.

**Graphite (Synthetic).**—Union Carbide Corp.'s Carbon Products Div. continued to operate its graphite specialties plant in Clarksburg. Graphite specialties included molds and dies used in producing crucibles for metals. In 1984, output and value increased nearly 44% and 29%, respectively, compared with that of 1983. The increase was largely attributable to the recent consolidation of the company's specialty line at the plant.

**Iron Oxide Pigments (Finished).**—West Virginia ranked third in the Nation in the shipment of finished iron oxide pigments. Mobay Chemical Corp., the State's sole producer, operated a plant in New Martinsville, Wetzel County. The iron oxide plant was built in 1979 to meet expanding U.S. markets for iron oxide pigments. Pigment production at the Mobay plant involves the reduction of nitrobenzene with scrap cast iron to produce iron oxide and aniline. Two basic colors, yellow and black, are manufactured in the initial production process and these are further processed and blended to produce the more than 50 colors in Mobay's Bayferrox line of pigments. The iron oxides are primarily used in both the paint and construction industries. Production and value increased principally because of the rebound in the construction industry.

Early in the year, Mobay Chemical and Local 566 of the International Chemical Workers Union reached an agreement on a 3-year contract for the New Martinsville plant. Included in the new package will be a $1,000 early contract bonus for each employee and an 87-cent-per-hour wage hike as well as increases in shift premiums, pensions, and health benefits.

Weirton Steel continued to produce regenerator iron oxide at its steel mill in Weirton.

**Lime.**—Both quicklime and hydrated lime were produced by Germany Valley Limestone Co., Pendleton County, the State's only lime producer in 1984. The lime was used principally in acid mine drainage neutralization, paper and pulp, BOF steel, sewage treatment, and water purification. Although total production of lime increased 16% over 1983 levels, the rise was largely attributable to the increase in quicklime. Quicklime production increased 70% while hydrated lime decreased nearly 11% during the same period.

During 1984, Germany Valley installed new systems for controlling fugitive dust from their lime kilns and built a new hydrating plant, which will more than double their hydrated lime capacity.

**Salt.**—Three companies produced salt brine from deep well solution mining operations in Marshall and Tyer Countries. Both output and value remained essentially the same as that of 1983.

In May, PPG brought on-stream a modernized, energy-efficient chlorine and caustic soda production circuit at its Natrium chemical plant. Startup of the circuit represents a key step toward completion of a $100 million plus modernization program begun in 1982. When the project is completed early in 1985, energy required for chlorine-caustic soda production will be reduced by 10%. The renewal involves replacing outmoded production components with modern electrolytic cell technology. An upgrading of production support facilities will complete the modernization. PPG is the leading U.S. merchant supplier of chlorine and caustic soda, which are coproduced through the electrolysis of brine.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

Output of construction sand and gravel increased about 39.4% in 1984 compared with 1983 levels reflecting increased contract construction in residential, nonresidential, highway, and public projects.

In 1984, four companies mined construction sand and gravel at four operations in three counties. Leading counties in order of output were Wetzel, Hancock, and Mason. Main uses for the material were for asphaltic and concrete aggregates, road base and coverings, and concrete products.

**Table 4.—West Virginia: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 744 | $2,447 | $3.29 |
| Asphaltic concrete | 165 | 560 | 3.39 |
| Road base and coverings | 30 | 83 | 2.75 |
| Fill | W | W | 4.00 |
| Snow and ice control | W | W | 2.13 |
| Other | 37 | 110 | 2.98 |
| Total or average | 976 | [1]3,198 | 3.28 |

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Data do not add to total shown because of independent rounding.

*Industrial.*—Industrial sand was produced by two companies in the State. Pennsylvania Glass Sand, the State's leading producer, operated a mine and plant at Berkeley Springs, Morgan County. The other producer was Tolers Sand Co. in Wyoming County. In 1984, production increased slightly compared with 1983 output. Leading end uses were for glass containers, flat glass, and specialty glass.

Pennsylvania Glass Sand announced in July that it was spending an estimated $6.6 million to modernize and expand four of its six silica plants. The Berkeley Springs facility was one of the four plants chosen where improvements will be made to its ground silica lines.

**Slag—Iron and Steel.**—Two companies, both in Weirton, processed slag produced by the State's steel industry. International Slag Co. processed steel slag produced by the basic oxygen process, and Standard Slag Co. processed air-cooled iron (blast furnace) slag.

In 1984, sales and value of iron and steel slag increased 33% and 31%, respectively. These increases were attributable to the increase in contract construction in the State during the year. The construction industry was the major user of iron and steel slag products. Air-cooled, blast furnace slag was used mainly for road base and coverings, fill, concrete aggregate, and as asphaltic concrete aggregate. Steel slag was typically used as road base and fill.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Based on preliminary estimates, 9.1 million short tons of crushed stone was produced valued at $37.3 million. The value of the total crushed stone accounted for nearly one-third of the State's total nonfuel production. Both limestone and sandstone were produced, with limestone accounting for the majority of the production. Major uses for the crushed stone were for construction aggregate, road base and coverings, concrete, and riprap.

During the year, Greer Limestone announced plans to expand its operations during the next 2 years, which would include an underground crushing facility at its main stone quarry at Greer. The process would mean primary crushing could be done in the mine prior to transporting the stone to the surface. Secondary crushing and fine grinding would then be done at the surface.

In October, the Jefferson County Commission tentatively agreed to Millville Quarry Inc.'s plan to add $1 million to an earlier $4 million industrial revenue bond proposal. The company requested the supplement after its bankers suggested that Millville Quarry upgrade its agricultural limestone plant at the same time that it modernizes its other facilities. The original $4 million bond proposal was approved by the commission in December 1983.[5]

Consolidation Coal successfully tested several limestone injection methods for reducing emissions of sulfur dioxide when coal is burned. The test was made at an E. I. du Pont de Nemours & Co. Inc. plant in Martinsville, VA, using high-sulfur coal from northern West Virginia. Sulfur released in coal-fired powerplants is blamed for acidic precipitation. Company officials said the tests demonstrate that the process of injecting limestone in the chamber where coal is burned will work technically but should be tested on larger boilers to prove if it can be used commercially.[6]

## METALS

**Aluminum.**—In May, Kaiser Aluminum & Chemical Corp. reactivated a third 40,750-short-ton-per-year potline at Ravenswood bringing the facility to 75% (122,250 tons) of its 163,000-ton operating capacity. Work on the restart of the third potline began in early March and nearly 100 laidoff workers were recalled to prepare and operate the line. With the recall, total employment at the Ravenswood works at yearend was about 2,400. When the plant was operating at its peak in 1981, nearly 4,130 workers were employed there; however, the Ravenswood plant is still the biggest employer in Jackson County.

**Ferroalloys.**—In 1984, three companies produced ferroalloys in the State: Foote Mineral Co. at its Graham plant, Mason County; Elkem Metals Co., at a plant in Graham, Fayette County; and Chemetals Corp., Kingwood, Preston County. Shipments in 1984 increased 65% compared with those of 1983.

In September, Federal legislation aimed at reestablishing a "breakpoint" price for ferroalloys was introduced. The amendment attached to the Omnibus Trade Bill (H.R. 3398), which was passed to the Senate from the House, sought to impose duties on imported ferroalloys sold at less than a fair market price. The price would be determined by a formula devised by the U.S. Department of Commerce and would be based on "reasonable costs of production in the United States plus general expenses and profit margins."

In an effort to regulate inventories and conserve its cashflow, Foote announced plans to reduce operations at its Graham ferrosilicon plant during November and December. One of the plant's three furnaces was shut down in November as a normal maintenance procedure. The Graham plant produced ferrosilicon and proprietary alloys made with ferrosilicon.

**Iron and Steel.**—Both shipments and value of pig iron increased nearly 20% in 1984, significantly higher than the national average, which increased 6% in shipments and 1% in value. Resurgence of Weirton Steel was the primary reason for the stronger demand.

In January, Weirton Steel officially became the Nation's largest company wholly owned by its employees. Plant employees voted overwhelmingly in September 1983 to take a 20% cut in wages and buy the plant from National Intergroup, formerly National Steel Corp. The plant, the largest employer in the area, employed about 7,200 workers; however, approximately 2,000 steelworkers were on layoff from the plant in 1984. The final legal obstacle to the employee takeover, a question of pension rights, was settled in May when the U.S. Supreme Court refused to hear a challenge to a lower court's ruling on the matter.

In February, Weirton Steel approved an estimated $62 million capital spending program that encompassed 44 different mill projects. A substantial part of the expenditures was slated for improvements in environmental protection facilities, including waste water quality control. Other projects included relining of blast furnaces and equipment modifications to improve product quality. Also, the company reopened its sinter plant, which had been closed since 1980. The sinter plant is the section of the facility where iron ore is prepared for use in the mill's blast furnaces. Four flue gas scrubber units and other emission controls were installed in order to bring the plant inline with Environmental Protection Agency air emission standards.

Wheeling-Pittsburgh Steel Corp. and Nisshin Ltd. of Japan reached an "agreement in principle" on a joint venture to build a $40 million steel coating mill in Follansbee. The 150,000-short-ton, 60-inch-wide galvanizing and aluminizing coating line is to be installed in the plant that was once operated by the Follansbee Steel Co. and later absorbed by Wheeling-Pittsburgh. Wheeling-Pittsburgh and Nisshin, the sixth largest steel producer in Japan, have formed Wheeling-Nisshin Inc., a joint venture company; Wheeling-Nisshin Coaters Inc., a subsidiary, will operate the coating line.

Steel of West Virginia, the State's only steel minimill, announced a $10 million renovation of its No. 2 mill and finishing area, which will continue through 1987. The plant, in Huntington, has an annual capacity to produce 250,000 tons of continuous billets and 150,000 tons of rolled products.

**Nickel.**—Inco Alloys International Inc. (formerly Huntington Alloys Inc.) produced wrought high-nickel alloys at its Huntington plant in Cabell County. The alloys were used by the energy, chemical, aerospace, and other major industries.

Anticipating an increase in demand for premium-quality nickel alloys for use in severe environments, Inco Alloys started operation of a new VIM furnace in late August. The $2 million, 15-ton furnace is part of a $10 million capital improvement project that also included installation of a 15-ton air melt furnace at Inco Alloys' Burnaugh, KY, plant and construction of a building to house the new VIM furnace. Inco Alloys, a subsidiary of Inco Ltd., Toronto, Canada, was formed early this year when the parent company brought two subsidiaries—Huntington Alloys Inc. of Huntington, and Wiggins Alloys Ltd. of Hereford, England—under one management.

**Silicon.**—Semix Corp., a subsidiary of Solarex Corp., Rockville, MD, operated a silicon metal plant in Martinsburg for only 6 weeks in 1984. The company, which produced solar-grade silicon metal for the manufacture of silicon wafers for photovoltaic cells, ceased operations in October because of a lack in demand. The firm announced that the plant was for sale.

**Zirconium.**—Corhart Refractories Co., a subsidiary of Corning Glass Works, produced several refractory products for the metallurgical industry—primarily for the manufacture of stainless steel.

The first of these is a chromic oxide refractory used primarily to line textile fiberglass tank sidewalls and channels. The very dense, low-porosity material is extremely corrosion resistant.

Two other glass fiber refractories produced by Corhart are manufactured using zirconium silicate materials as a base. The first of these is a chemically inert, very dense product, which is employed in bottom pavings and iron forehearth rails of textile fiberglass tanks. The second, very resistant to thermal shock, is used to manufacture fiberglass bushing blocks.

The plant also produces a very dense tin oxide refractory, which is very corrosion resistant. Its principal application in the glass industry is for electrodes in direct glass melting or as electrical boosting in conventional gas- or oil-fired furnaces.[7]

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA.

[2] Economic geologist and head, Economic Section, West Virginia Geological and Economic Survey, Morgantown, WV.

[3] Kirstein, D. S. Construction Aggregates in West Virginia: Where, How, and Why? WV Geol. and Econ. Surv., Mountain State Geol. Mag., 1985, pp. 30-33.

Welker, D. B., and C. M. Simard. Dimension Stone of West Virginia. WV Geol. and Econ. Surv., Open File Rep. OF8422, 1983, 37 pp.

Kirstein, D. S., and S. Maple. West Virginia Mineral Producers and Processors Directory. WV Geol. and Econ. Surv., MRS-1, 11th ed., 1984, 132 pp.

Kirstein, D. S. West Virginia Mineral Industry Status. WV Geol. and Econ. Surv., MB-1, 1984, 28 pp.

[4] Simard, C. M. Grahamite and the Ritchie Mine. WV Geol. and Econ. Surv., Mountain State Geol. Mag., 1985, pp. 13-15.

[5] Daily Mail (Charleston, WV). Oct. 9, 1984, p. 11.

[6] ———. Oct. 19, 1984, p. 34.

[7] Brick & Clay Record. Systems Approach Gives Double-Duty Plant an Edge. Apr. 1984, pp. 48-50.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Aluminum: | | | |
| Kaiser Aluminum & Chemical Corp. | Box 98<br>Ravenswood, WV 26164 | Smelter and fabricating plant. | Jackson. |
| Cement: | | | |
| Capital Cement Corp.[1] | Box 885<br>Martinsburg, WV 25401 | Quarry and plant | Berkeley. |
| Clays: | | | |
| Continental Brick Co | Box 1111<br>Martinsburg, WV 25401 | Pit and plant | Do. |
| Globe Refractories Inc | Box D<br>Newell, WV 26050 | Underground mine | Hancock. |
| Sanders Dummy Co | Box 24<br>Midkiff, WV 25504 | Pit | Lincoln. |
| Iron oxide pigments (finished): | | | |
| Mobay Chemical Corp | Penn Lincoln Parkway West<br>Pittsburgh, PA 15205 | Plant | Wetzel. |
| Lime: | | | |
| Germany Valley Limestone Co | Box 302<br>Riverton, WV 26814 | Quarry and plant | Pendleton. |
| Salt: | | | |
| FMC Corp | Box 8127<br>South Charleston, WV 25303 | Brine wells | Tyler. |
| LCP Chemicals-West Virginia Inc. | Drawer J<br>Moundsville, WV 26041 | Brine wells and plant | Marshall. |
| PPG Industries Inc | 1 Gateway Center<br>Pittsburgh, PA 15222 | do | Do. |
| Sand and gravel: | | | |
| Construction: | | | |
| Dravo Corp | 1 Oliver Plaza<br>Pittsburgh, PA 15222 | Dredges | Various. |
| ET&S Inc | Route 1<br>Cheshire, OH 45620 | Quarry and plant | Mason. |
| Mason County Sand & Gravel Inc. | Route 2, Box 166-A<br>Letart, WV 25253 | do | Do. |
| Standard Slag Co.[2] | Box 448<br>Weirton, WV 26062 | Plant | Hancock. |
| Industrial: | | | |
| Pennsylvania Glass Sand Corp. | Box 187<br>Berkeley Springs, WV 25411 | Quarry and plant | Morgan. |
| Tolers Sand Co | Route 1, Box 132B<br>Welch, WV 24801 | Dredge | Wyoming. |
| Stone (crushed, 1983): | | | |
| Acme Limestone Co | Box 27<br>Fort Spring, WV 24936 | Mine and quarry | Greenbrier. |
| Fairfax Sand & Crushed Stone Co. | Box 98<br>Thomas, WV 26292 | Quarries | Grant, Mineral, Randolph. |
| Greer Limestone Co., a division of Greer Steel Co. | Greer Bldg.<br>Morgantown, WV 26505 | Mine and quarries | Monongalia and Pendleton. |
| Lone Star Industries Inc | Route 3, Box 489<br>Morgantown, WV 26505 | Mine | Monongalia. |
| United States Steel Corp | 600 Grant St.<br>Pittsburgh, PA 15230 | Quarry | Jefferson. |

[1] Also clays and crushed stone.

[2] Also iron slag.

# The Mineral Industry of Wisconsin

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Wisconsin Geological and Natural History Survey for collecting information on all nonfuel minerals.**

**By James J. Hill,[1] Thomas J. Evans,[2] and Wanda J. West[3]**

Wisconsin's nonfuel mineral production was valued at $129.3 million in 1984. Nationally, the State ranked 36th in value of mineral output. After dropping to an 11-year low in 1983, mineral production value increased modestly because of gains in housing and other building activity that expanded demand for mineral commodities used in construction. Sales of crushed stone and construction sand and gravel accounted for 64% of the State's mineral value. Portland cement had the greatest increase in sales value, followed by industrial sand, masonry cement, construction sand and gravel, peat, and abrasive stone. Mineral commodities processed in Wisconsin from out-of-State sources included iron oxide pigments, perlite, and vermiculite. Sulfur was recovered as a refinery byproduct. No metallic minerals were produced in the State.

**Table 1.—Nonfuel mineral production in Wisconsin[1]**

| Mineral | 1983 Quantity | 1983 Value (thousands) | 1984 Quantity | 1984 Value (thousands) |
|---|---|---|---|---|
| Lime thousand short tons | 319 | $17,624 | 373 | $19,892 |
| Peat do | 9 | W | 9 | W |
| Sand and gravel: | | | | |
| Construction do | [e]14,200 | [e]28,800 | 17,785 | 38,245 |
| Industrial do | 621 | 7,208 | 1,060 | 11,821 |
| Stone: | | | | |
| Crushed do | 14,252 | 39,896 | [e]15,800 | [e]45,000 |
| Dimension do | 24 | 2,884 | [e]24 | [e]2,863 |
| Combined value of abrasive stone, cement, and values indicated by symbol W | XX | 4,779 | XX | 11,527 |
| Total | XX | 101,191 | XX | 129,348 |

[e] Estimated. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Wisconsin, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Adams | $43 | (3) | |
| Ashland | 55 | (3) | |
| Barron | 251 | (3) | |
| Bayfield | 1 | (3) | |
| Brown | W | W | Lime, stone (crushed). |
| Buffalo | 16 | $339 | Stone (crushed). |
| Burnett | 207 | (3) | |
| Calumet | W | W | Stone (crushed), stone (dimension). |
| Chippewa | 103 | (3) | |
| Clark | 364 | W | Stone (crushed). |
| Columbia | W | W | Sand (industrial), stone (crushed). |
| Crawford | W | W | Stone (crushed). |
| Dane | 944 | 1,928 | Do. |
| Dodge | W | W | Stone (crushed), lime. |
| Door | 559 | W | Stone (crushed). |
| Douglas | W | W | Lime, stone (crushed). |
| Dunn | W | 185 | Stone (crushed). |
| Eau Claire | W | (3) | |
| Fond du Lac | W | 1,841 | Stone (crushed), lime, stone (dimension). |
| Forest | 109 | (3) | |
| Grant | (3) | 1,108 | Stone (crushed). |
| Green | (3) | W | Do. |
| Green Lake | W | W | Sand (industrial), stone (crushed). |
| Iowa | (3) | 1,211 | Stone (crushed). |
| Iron | W | (3) | |
| Jackson | W | W | Sand (industrial). |
| Jefferson | 102 | 365 | Stone (crushed). |
| Juneau | 25 | W | Do. |
| Kenosha | 1,474 | (3) | |
| Kewaunee | 234 | (3) | |
| La Crosse | 34 | W | Stone (crushed). |
| Lafayette | (3) | 791 | Do. |
| Langlade | W | (3) | |
| Lincoln | 229 | (3) | |
| Manitowoc | W | W | Lime, stone (crushed). |
| Marathon | 659 | 4,681 | Stone (crushed), stone (dimension). |
| Marinette | 62 | W | Sand (industrial), stone (crushed), stone (dimension). |
| Marquette | 140 | (3) | |
| Milwaukee | W | W | Cement, stone (crushed). |
| Monroe | (3) | 1,441 | Stone (crushed). |
| Oconto | 348 | W | Do. |
| Oneida | 448 | (3) | |
| Outagamie | (3) | 1,469 | Stone (crushed). |
| Ozaukee | 364 | W | Do. |
| Pepin | 40 | 19 | Do. |
| Pierce | W | 954 | Stone (crushed), sand (industrial). |
| Polk | 135 | W | Stone (crushed). |
| Portage | 1,405 | (3) | |
| Price | 42 | (3) | |
| Racine | 871 | W | Stone (crushed). |
| Richland | 12 | 135 | Do. |
| Rock | 1,423 | 1,221 | Do. |
| Rusk | 388 | (3) | |
| St. Croix | 370 | W | Stone (crushed). |
| Sauk | W | W | Stone (crushed), abrasive stone. |
| Sawyer | W | (3) | |
| Shawano | 567 | W | Stone (crushed). |
| Sheboygan | 601 | W | Do. |
| Taylor | 684 | (3) | |
| Trempealeau | (3) | W | Stone (crushed). |
| Vernon | (3) | W | Do. |
| Vilas | 138 | (3) | |
| Walworth | 872 | W | Stone (crushed). |
| Washburn | W | (3) | |
| Washington | 1,487 | W | Stone (crushed). |
| Waukesha | W | W | Stone (crushed), peat, stone (dimension). |
| Waupaca | 609 | 87 | Stone (crushed). |
| Waushara | W | (3) | |
| Winnebago | W | 1,170 | Stone (crushed). |
| Wood | (3) | W | Do. |
| Undistributed[4] | 56,550 | 53,446 | |
| Sand and gravel (construction) | XX | [e]28,800 | |

See footnotes at end of table.

## Table 2.—Value of nonfuel mineral production in Wisconsin, by county[1] —Continued

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Stone: | | | |
| Crushed | [e]$36,100 | XX | |
| Dimension | [r] [e]2,815 | XX | |
| Total | [r]111,880 | $101,191 | |

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[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] Florence and Menominee Counties are not listed because no nonfuel mineral production was reported.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Stone, either crushed or dimension, was produced; data not available by county. Total State values are shown separately under "Stone."

[4] Includes construction sand and gravel that cannot be assigned to specific counties (1982) and values indicated by symbol W.

## Table 3.—Indicators of Wisconsin business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 4,745 | 4,746 | 4,766 |
| Total civilian labor force | do | 2,440 | 2,426 | 2,394 |
| Unemployment | do | 260 | 253 | 176 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do | 1.9 | 1.9 | 1.8 |
| Metal mining[2] | do | .2 | .1 | NA |
| Nonmetallic minerals[2] | do | 1.6 | 1.8 | 1.8 |
| Manufacturing total | do | 498.2 | 484.1 | 517.8 |
| Primary metal industries | do | 20.1 | 17.6 | 19.9 |
| Stone, clay, and glass products | do | 7.9 | 7.8 | 7.4 |
| Chemicals and allied products | do | 9.3 | 9.3 | 9.9 |
| Petroleum and coal products[2] | do | .4 | .4 | NA |
| Construction | do | 56.9 | 57.7 | 58.3 |
| Transportation and public utilities | do | 89.4 | 88.1 | 89.7 |
| Wholesale and retail trade | do | 428.9 | 433.3 | 453.8 |
| Finance, insurance, real estate | do | 95.8 | 98.6 | 102.2 |
| Services | do | 381.4 | 388.6 | 403.9 |
| Government and government enterprises | do | 314.1 | 312.5 | 318.6 |
| Total[3] | do | 1,866.7 | 1,864.6 | 1,941.1 |
| Personal income: | | | | |
| Total | millions | $51,143 | $53,654 | $59,453 |
| Per capita | | $10,778 | $11,305 | $12,474 |
| Hours and earnings: | | | | |
| Total average weekly hours, production workers | | 39.6 | 40.7 | 41.4 |
| Total average hourly earnings, production workers | | $9.37 | $9.78 | $10.03 |
| Earnings by industry: | | | | |
| Farm income | millions | $1,442 | $1,343 | $2,247 |
| Nonfarm | do | $34,178 | $35,972 | $39,551 |
| Mining total | do | $47 | $46 | $48 |
| Metal mining | do | $6 | $3 | $2 |
| Nonmetallic minerals | do | $35 | $41 | $42 |
| Manufacturing total | do | $11,816 | $12,197 | $13,704 |
| Primary metal industries | do | $496 | $472 | $575 |
| Stone, clay, and glass products | do | $177 | $183 | $202 |
| Chemicals and allied products | do | $259 | $277 | $304 |
| Petroleum and coal products | do | $14 | $16 | $17 |
| Construction | do | $1,473 | $1,570 | $1,792 |
| Transportation and public utilities | do | $2,332 | $2,431 | $2,622 |
| Wholesale and retail trade | do | $5,414 | $5,675 | $6,149 |
| Finance, insurance, real estate | do | $1,766 | $1,980 | $2,154 |
| Services | do | $6,020 | $6,462 | $7,092 |
| Government and government enterprises | do | $5,184 | $5,477 | $5,839 |
| Construction activity: | | | | |
| Number of private and public residential units authorized | | 12,312 | 16,962 | 16,719 |
| Value of nonresidential construction | millions | $633.8 | $730.9 | $783.8 |
| Value of State road contract awards | do | $173.3 | $293.2 | $235.9 |
| Shipments of portland and masonry cement to and within the State | thousand short tons | 1,080 | 1,283 | 1,458 |

See footnotes at end of table.

Table 3.—Indicators of Wisconsin business activity —Continued

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $111.9 | $101.2 | $129.3 |
| Value per capita | $24 | $21 | $27 |

[p]Preliminary. [r]Revised. NA Not available.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data may not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

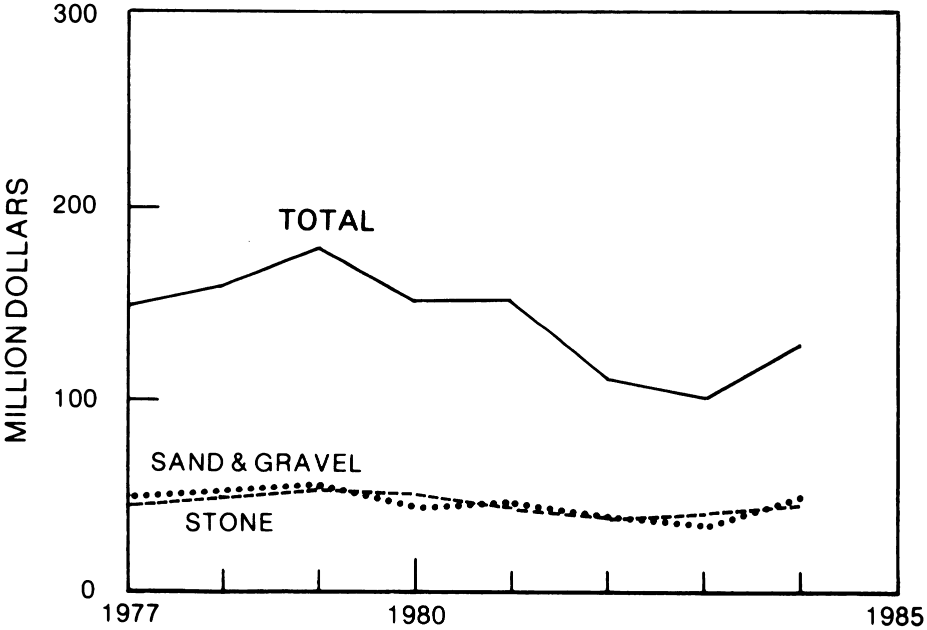

Figure 1.—Value of sand and gravel and stone and total value of nonfuel mineral production in Wisconsin.

**Trends and Developments.**—Environmental assessment of Exxon Minerals Co.'s Crandon Project continued in 1984. The discovery of the 67.4-million-metric-ton zinc-copper ore body was announced in May 1976. The proposed mine-mill complex has been the object of numerous environmental baseline, engineering design, and operational modeling investigations that have continued since Exxon submitted its initial permit applications and environmental report in late 1982. Primary areas of public concern in 1984 were the assessment of the socioeconomic impacts of the proposed mine-mill complex, design of the mine-waste disposal facility, and modeling of ground water effects of mine dewatering. At yearend, the draft Environmental Impact Statement for the project was expected to be released in mid-1985, with decisions on relevant permits expected in late 1986.

Intensive full-scale reclamation was under way at the Jackson County Iron Co. taconite minesite that closed in October 1983. Efforts focused on reseeding the mine dumps and tailings basin. A perimeter fence was installed to restrict access to the 130-acre pit that has been steadily filling with

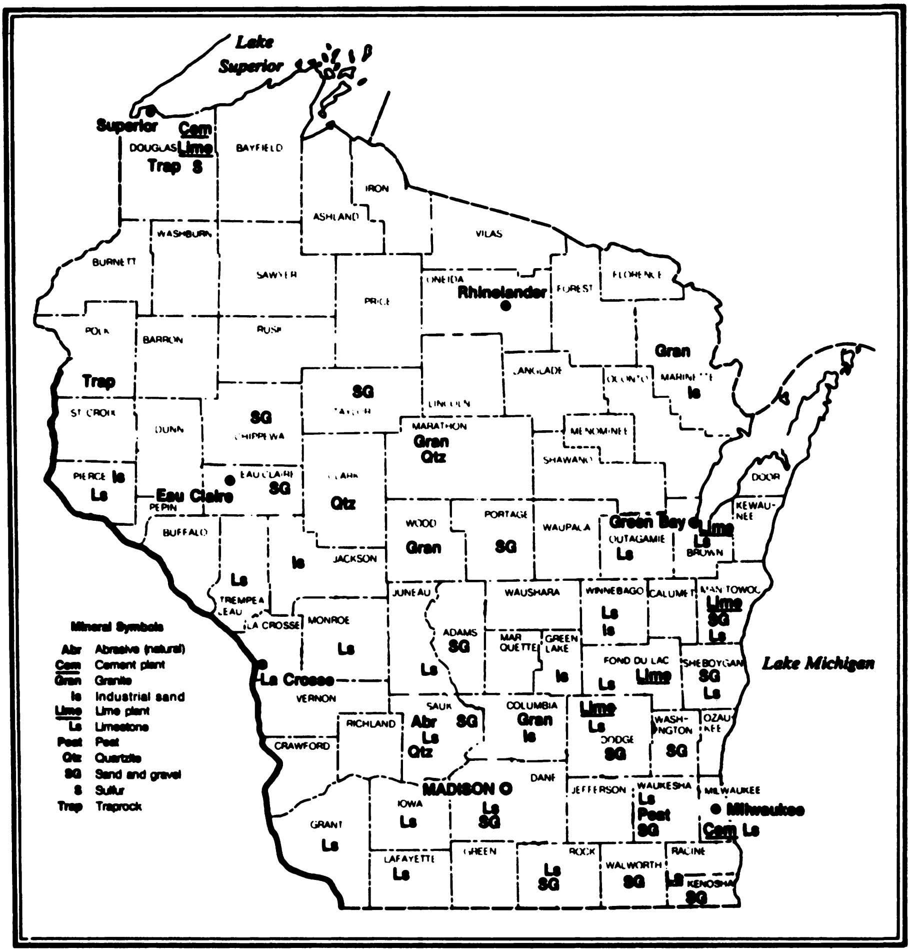

Figure 2.—Principal mineral producing localities in Wisconsin.

water. When filled, the pit will become one of the deepest lakes in Wisconsin. Local authorities have been actively involved in trying to attract new users for the mine-mill site, which has power and rail and highway access.

**Employment.**—Wisconsin's economy continued to expand in 1984. The State Department of Industry, Labor, and Human Relations (DILHR) reported the State's average monthly unemployment rate (unadjusted) dropped from 10.4% in 1983 to 7.7% in 1984, a 26% change. Each percentage point in the State's unemployment rate in 1984 represented 24,000 persons. Employment in the mining sector decreased 5% from about 1,900 workers in 1983 to 1,800 in 1984. Average annual earnings increased from $22,204 in 1983 to $22,520 in 1984. Employment in the State's iron and steel foundries increased 15.6%, from 9,600 workers in 1983 to 11,100 in 1984.

DILHR reported no strikes in 1984 within the industrial classifications of mining nonmetallic minerals; stone, clay, glass, and concrete products; or the fabricated metal industries. However, in the primary metal industries, Anaconda American Brass Co. at Kenosha was on strike from April 9 to April 30 with 665 workers involved.

The number of building plans examined for compliance with the State's commercial building code in 1984 increased 24% compared with that of 1983. This building activity had a positive effect on employment and created increased demand for mineral commodities used in construction.

During 1984, the Wisconsin Department of Transportation awarded or approved highway construction contracts and agreements totaling $235.6 million,[4] approximately 1.7% more than the all-time record high of $231.7 million committed in 1983. This increased activity also stimulated demand for mineral commodities used in construction and provided job opportunities.

The Wisconsin Department of Development reported that new industry and plant expansions in the State's manufacturing sector increased for the second consecutive year, from 282 projects in 1983 to 320 projects in 1984. The capital investment projects were expected to provide 5,701 new manufacturing jobs, 16% higher than in 1983. Total capital investment was $386.2 million.

**Exploration Activities.**—Metallic mineral exploration drilling occurred in 10 counties during 1984. Of the 18 companies licensed to explore in the State, 8 actually drilled holes. In 1984, 54 holes were drilled compared with 74 in 1983. Thirty-one of the drill holes were completed in Lafayette and Pierce Counties, outside of the Proterozoic metavolcanic terrane in northern Wisconsin—the geologic environment in which most base metal exploration has occurred during the past 10 years. The Pierce County drilling featured a series of closely spaced shallow holes for an unspecified metallic mineral. Occurrences of gold and diamonds have been reported in the general area in the past but have not been substantiated.

In Lafayette County and adjoining Grant County, part of the Upper Mississippi Valley zinc-lead district, drilling was for zinc and lead. Mining ended in the district in 1979 because it was no longer profitable, although substantial reserves are known to exist. Other metallic mineral exploration was spread across north-central Wisconsin in Chippewa, Iron, Lincoln, Marathon, Price, Rusk, and Taylor Counties. Drilling activity during 1984 is summarized in table 4.

### Table 4.—Wisconsin: Metallic mineral exploration in 1984

| Licensed exploration companies | Number of drill holes | Total footage drilled |
|---|---|---|
| AMAX Exploration Inc | 2 | 890 |
| American Copper & Nickel Co. Inc | 4 | 1,391 |
| Inspiration Development Co | 2 | 1,136 |
| Kerr-McGee Corp | 6 | 3,695 |
| Ernest K. Lehmann & Associates of Wisconsin Inc | 5 | 3,438 |
| Mobil Mineral Resources Inc | 15 | 3,130 |
| Superior Mining Co | 19 | 1,612 |
| United States Borax & Chemical Corp | 1 | 1,372 |
| Total | 54 | 16,664 |

Source: Wisconsin Geological and Natural History Survey. Metallic Mineral Exploration in Wisconsin, Summary of 1984 Activity.

Numerous articles about diamond exploration activities in several northeastern Wisconsin counties appeared in the local press during 1984. A mineralogy buff reportedly found several small diamonds in glacial debris near Antigo in Langlade County. Prospecting was also reported in Florence and Forest Counties. Across the border in Michigan, Dow Chemical Co. was prospecting a kimberlite deposit that it had leased from the State. Several other companies were also known to be prospecting in the region.

Leasing activity for metallic minerals was down more than 80% during the year, totaling slightly more than 2,700 new acres leased.[5] This was the lowest annual total since records of metallic mineral leasing activity became available in 1978. The parcels leased included acreage in six counties.

In contrast with metallic minerals, leasing of private and public lands for oil and gas exploration greatly accelerated in 1984. Seven exploration companies or land acquisition firms acquired nearly 200,000 acres of land through leases, bringing the total oil and gas acreage leased to over 225,000 acres. At yearend, many acres of public lands, principally county forests and parcels within the Chequamegon National Forest, were under active negotiation for lease. Lease applications were estimated to cover more than 1 million acres. The principal companies involved in oil and gas leasing included Amoco Production Co., Benchmark Resources Corp., Texaco Inc., and Chevron U.S.A. Inc.

**Shipping.**—Waterborne commerce passing through the Port of Duluth-Superior totaled 32.5 million metric tons in 1984, about 13% more than the 28.8 million tons reported in 1983.[6] Iron ore and concentrates shipped to domestic ports totaled 17.4 million tons in 1984, about 22% more than the 14.3 million tons shipped in 1983. Shipments to Canadian ports totaled 1.8 million tons compared with 1.5 million tons in 1983. The American Iron Ore Association reported 11.3 million tons of iron ore and concentrates shipped through the Burlington Northern Inc. facility on Allouez Bay in Superior in 1984. This was about 29% more than was shipped in 1983. Burlington Northern loaded its first cargo on April 4 and its final cargo on December 22.

Limestone and limestone products delivered to the port from Canadian and domestic sources totaled 994,671 metric tons in 1984 compared with 963,674 tons delivered in 1983. Some of these products were delivered to the CLM Corp. lime plant and the Huron Cement Div. of National Gypsum Co. clinker-grinding facility in Superior. Other products went to a cement distributor in Duluth, and some limestone was trucked to sugar refineries in western Minnesota.

The Midwest Energy Terminal in Superior shipped a record high 6.7 million short tons of low-sulfur Montana coal to Michigan power generating plants in 1984. In 1983, 5.7 million tons was shipped.

Approximately 2.5 million tons of cargo passed through the Port of Green Bay in 1984, compared with 2.3 million tons in 1983. This commerce resulted in an economic impact of over $35 million on the surrounding area. The major mineral commodities entering the port, in order of tonnage, were coal, limestone, cement, and salt.

The Port of Milwaukee reported a 21% increase in waterborne cargo shipped through the port. A large amount of crushed limestone was imported for a new dockwall extension under construction by the Milwaukee Metropolitan Sewerage District. Receipts of sand for the area's foundries showed the greatest increase in tonnage, and receipts of pig iron for area foundries also showed a sizable increase. Cement was imported for area distribution terminals. Clinker and gypsum were imported for use at a local cement grinding facility. Salt was imported for use in snow and ice removal.

**Table 5.—Port of Milwaukee: Selected nonfuel mineral commodity imports[1]**

(Short tons)

| Commodity | 1983 | 1984 |
|---|---|---|
| Cement | 330,037 | 388,796 |
| Clinker | 92,000 | 81,219 |
| Concrete aggregate | -- | 11,067 |
| Gypsum | 4,400 | 6,110 |
| Limestone | -- | 129,295 |
| Pig iron | [r]51,580 | 67,445 |
| Potash | 11,821 | -- |
| Salt | 388,058 | 524,393 |
| Sand | 10,782 | 44,985 |
| Total | [r]888,678 | 1,253,310 |

[r] Revised.

[1] Includes Canadian imports and domestic receipts.

Source: 1984 Annual Report, Port of Milwaukee, U.S.A.

The Lake Carriers Association reported no U.S. flag carriers or tankers were built for Great Lakes service in 1984 nor were any under construction.

**Legislation and Government Programs.**—In 1984, the Wisconsin Legislature passed four laws affecting the mineral industry. Act 176 authorized nonmetallic mining reclamation ordinances and gave preeminence to county government ordinances over town ordinances with respect to nonmetallic mining. The passage of this legislation culminated an effort of more than 5 years to develop statutory authority on upland mining operations within the State. Act 335 provided an exemption for metallic minerals mining leases and oil and gas exploration leases from the State's limitation of land ownership by nonresident aliens. The restriction of alien ownership to 640 acres posed a significant concern to foreign-owned corporations involved in mineral exploration and potential mineral development. Act 455 required the registration of severed mineral interests in the State. Based on the dormant-minerals approach, the new law provided a 3-year period (July 1, 1984, to July 1, 1987) for owners of severed mineral interests to use their minerals. "Use of minerals" was broadly defined and included registering a statement of mineral claim, leasing the minerals, extracting a mineral resource, or paying a tax on the mineral interest. Act 517 modified the statutes relating to determining when abandonment of metallic mining occurs. Determination of abandonment triggers mandatory reclamation activities, and the new law provided a somewhat more lenient time frame for the Department of Natural Resources (DNR) decisionmaking in this regard.

A bill that would give the DNR explicit authority to regulate oil and gas exploratory drilling, SB 638, was introduced in 1984 but failed to move forward rapidly enough to receive any floor action. The DNR, citing its general authority to protect the waters of the State, proceeded with drafting administrative rules for oil and gas exploration. Hearings on the proposed Natural Resources rules, NR134, were scheduled at yearend.

The Mining Investment and Local Impact Fund Board disbursed more than $500,000, principally to local governments in the vicinity of Exxon's proposed Crandon Project. Disbursements in 1984 included $416,400 in permit-period payments to four local governments, as mandated by State law; $27,847 to governmental units near Jackson County Iron's now-closed Black River Falls taconite mine; and $58,190 in discretionary grants to local units of government to support local impact committees, certain legal services, and technical or project-related support. The Mining Investment and Local Impact Fund Board's funding sources include loans from general purpose revenues, the net proceeds tax on metallic mining, and the iron ore concentrate tax.

The Wisconsin Geological and Natural History Survey published the first reconnaissance bedrock geology map in its new 1:250,000-scale map series by releasing the "Bedrock Geology of Northeast Wisconsin." This mapping program continued throughout the year with work on the west-central, east-central, and northwest sheets. Reconnaissance bedrock geologic mapping was also initiated in the southwestern area during the year. The survey also published a new, comprehensive report and map (scale 1:100,000) of bedrock geology in Marathon County.[7] The report presents a major analysis of this Precambrian terrane that ranges in age from Archean to Middle Proterozoic and includes a wide range of rock types and mineralization. The survey was also preparing Pleistocene maps of 12 counties at a scale of 1:100,000.

During the year, the U.S. Congress passed the Wisconsin Wilderness Act of 1984, which became Public Law 98-321 on June 19, 1984. Four National Forest areas were designated "wilderness" and became components of the National Wilderness Preservation System. The areas included 4,235 acres known as the Porcupine Lake Area of Chequamegon National Forest in Bayfield County and several portions of the Nicolet National Forest in Forest County, known collectively as the Headwaters Wilderness. Headwaters consists of the Kimball Creek Unit (7,527 acres), Headwaters of the Pine Unit (8,872 acres), and the Shelp Lake Unit (3,705 acres). These areas had previously been designated as suitable for wilderness preservation under the U.S. Forest Service Roadless Area Review and Evaluation (RARE II) program.

Wisconsin received $728,750 from the Federal Government during fiscal year 1984 for its share of funds generated by activities (timbering, mineral leasing, recreation, user fees, etc.) on national forest lands. This figure compares with $556,500 the State received in fiscal year 1983.

The U.S. Bureau of Land Management (BLM) continued to work on its plan to dispose of its public domain lands in Wisconsin. BLM administers approximately 4,200 acres of public lands consisting of nearly 830 tracts scattered throughout 59 Wisconsin counties. Federal mineral ownership under State, county, and private surface ownership totals approximately 148,000 acres. Management responsibilities of the lands would be transferred to other Federal, State, or local agencies that could do a better job of on-site management. During 1984, a Memorandum of Understanding between BLM and Wisconsin was signed to facilitate the land exchange. Meetings were held with Wisconsin DNR officials to refine the list of islands identified to be transferred to the State for recreation and public purposes. A summary of the management situation and draft of preferred alternatives were distributed to Federal, State, and local government agencies and the general public for review and comment. BLM planned to release the Wisconsin Proposed Plan and Environmental Assessment in early 1985.

The U.S. Bureau of Mines had several active contracts and grants with industrial firms, educational institutions, and consulting firms in Wisconsin for services and equipment. Funding for these services was approximately $180,000 in fiscal year 1984.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Abrasive Stone.**—Baraboo Quartzite Co. Inc. continued to mine quartzite at its quarry near Baraboo, Sauk County, for use as a deburring and burnishing medium. This is one of two quarries in the United States reporting to the U.S. Bureau of Mines this type of use for its stone. The extremely hard stone is crushed, tumbled, sized, and packaged in 100-pound bags for shipment to metal stamping plants in several States and foreign countries. Shipments increased about 27% over those of 1983.

**Cement.**—Two companies operated clinker-grinding facilities during 1984. National Gypsum, Huron Cement Div., operated a plant at Superior, and St. Marys Wisconsin Cement Inc., a subsidiary of St. Marys Cement Ltd., operated a plant at Milwaukee. Both companies ship in clinker and other materials for their cement from out-of-State sources. Shipments of portland cement increased dramatically when compared with 1983 figures, but value per short ton decreased about 5%. Part of the large increase in shipments can be attributed to National Gypsum's resumption of production at its Superior plant in early 1984 after being inactive since September 1982. Both companies produced Types I and II, general use and moderate heat portland cement. St. Marys also produced masonry cement. Shipments of masonry cement increased about 22% and value per ton increased 29% compared with 1983 figures.

Major sales of cement were to ready-mixed concrete companies, followed by concrete product manufacturers and highway contractors. Most of the cement produced in the State was shipped in bulk form. All shipments were by truck.

**Lime.**—Nationally, Wisconsin ranked 13th of 38 States producing lime. In terms of value, lime was the third most important mineral commodity produced in the State, following crushed stone and sand and gravel. Three companies produced lime at five plants. CLM operated a plant at Superior in Douglas County, Rockwell Lime Co. operated a plant at Manitowoc in Manitowoc County, and Western Lime & Cement Co. operated plants in Brown, Dodge, and Fond du Lac Counties. Both quicklime and hydrated lime were produced at each of the plants. Lime production increased about 17% compared with 1983 figures. The average price per short ton dropped about 3%. Quicklime accounted for about 72% of lime sales. Wisconsin ranked first in the production of mason's lime with 21% of the Nation's total and also was a leading producer of lime for the paper and pulp industry with 11% of the U.S. total. About 141,000 short tons of lime (from all domestic sources) was consumed in Wisconsin during 1984, down from the 154,000 tons reported in 1983.

During the year, Western Lime continued construction on a new rotary kiln unit at its Eden plant in Fond du Lac County. In late December, the kiln was fired for the first time for an operational check. The kiln was expected to be placed in full operation in early 1985. Maximum capacity was to be 250 tons of quicklime per day. With the addition of the rotary kiln at the Eden plant, Western Lime planned to shut down the shaft kilns at its Knowles plant and operate only a pressure hydrator, mortar blender, and a bagging plant at the site. Quicklime would be supplied from the Eden plant.[8]

**Peat.**—Waukesha County, with three producers, accounted for all of Wisconsin's peat output in 1984. Peat for general soil improvement was produced from bogs near New Berlin by Bogda's Top Soil & Excavating Co. and Certified Peat & Sod Inc. Demilco Inc., a division of Nitragin Sales Corp., produced reed-sedge peat near Delafield that it sold in bulk and packaged form for use as an ingredient for seed inoculant.

Sales of peat increased about 6% compared with 1983 figures. Value increased about 31%.

**Perlite (Expanded).**—Midwest Perlite Co. expanded crude perlite obtained from mines in Western States at its Appleton plant in Outagamie County. Sales increased slightly during the year; value per short ton increased about $2.00. Major use of the product was for horticultural purposes; lesser quantities were used as concrete and plaster aggregates and cavity fill insulation.

**Sand and Gravel.**—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; the 1983 chapter gave estimates. Data for odd-numbered years are based on annual company estimates made before yearend.

Nationally, Wisconsin ranked 13th in the production of construction sand and gravel. Sand and gravel used in construction accounted for 30% of Wisconsin's nonfuel mineral value. Production occurred in 60 of the State's 72 counties. There were 160 producers extracting sand and gravel at 304 locations. Production increased 25% during the year; value per short ton increased 6%. Increased sales were the result of a stronger economy and an expansion in housing and other construction.

**Table 6.—Wisconsin: Construction sand and gravel sold or used in 1984, by major use category**

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 3,494 | $9,050 | $2.59 |
| Plaster and gunite sands | 50 | 95 | 1.90 |
| Concrete products | 179 | 451 | 2.51 |
| Asphaltic concrete | 1,307 | 2,948 | 2.25 |
| Road base and coverings[1] | 4,580 | 8,812 | 1.92 |
| Fill | 1,128 | 1,774 | 1.57 |
| Snow and ice control | 177 | 351 | 1.99 |
| Railroad ballast | 17 | 122 | 7.11 |
| Other | 6,853 | 14,642 | 2.14 |
| Total or average | 17,785 | 38,245 | 2.15 |

[1] Includes road and other stabilization (cement and lime).

**Table 7.—Wisconsin: Construction sand and gravel sold or used by producers, by county**

| County | 1982 | | | 1984 | | |
|---|---|---|---|---|---|---|
| | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| Adams | 1 | 30 | $43 | 2 | W | W |
| Ashland | 2 | 34 | 55 | 2 | W | W |
| Barron | 9 | 129 | 251 | 10 | 218 | $464 |
| Bayfield | 1 | 1 | 1 | 1 | W | W |
| Brown | 1 | W | W | 4 | 216 | 652 |
| Buffalo | 3 | 10 | 16 | 2 | 14 | 22 |
| Burnett | 3 | 78 | 207 | 3 | 42 | 85 |
| Calumet | 1 | W | W | 1 | 15 | 33 |
| Chippewa | 1 | 61 | 103 | 10 | 461 | 726 |
| Clark | 2 | 126 | 364 | 3 | 201 | 345 |
| Columbia | -- | -- | -- | 3 | 267 | 836 |
| Crawford | 2 | W | W | 1 | 73 | 262 |
| Dane | 13 | 444 | 944 | 14 | 821 | 2,030 |
| Dodge | 5 | 107 | 170 | 13 | W | W |
| Door | 17 | 220 | 559 | 9 | 146 | 288 |
| Douglas | 2 | 35 | 183 | 2 | 65 | 363 |
| Dunn | 2 | W | W | 1 | 51 | 76 |
| Eau Claire | 2 | W | W | 3 | 459 | 810 |
| Florence | -- | -- | -- | 1 | 10 | 18 |
| Fond du Lac | 2 | W | W | 5 | 159 | 223 |
| Forest | 1 | 45 | 109 | 6 | 65 | 179 |
| Green Lake | 2 | 55 | 167 | 2 | 252 | 556 |
| Jackson | 2 | W | W | 5 | 359 | 1,155 |
| Jefferson | 2 | 47 | 102 | 2 | 56 | 115 |
| Juneau | 8 | 17 | 25 | -- | -- | -- |
| Kenosha | 4 | 569 | 1,474 | 4 | 424 | 1,056 |
| Kewaunee | 7 | 153 | 234 | 3 | 84 | 305 |

See footnotes at end of table.

### Table 7.—Wisconsin: Construction sand and gravel sold or used by producers, by county —Continued

| County | 1982 |  |  | 1984 |  |  |
|---|---|---|---|---|---|---|
|  | Number of mines | Quantity (thousand short tons) | Value (thousands) | Number of mines | Quantity (thousand short tons) | Value (thousands) |
| La Crosse | 1 | 34 | $34 | 1 | 20 | $45 |
| Langlade | 2 | W | W | 7 | 262 | W |
| Lincoln | 11 | 144 | 229 | 11 | 232 | 431 |
| Manitowoc | 8 | 851 | 1,392 | 15 | 489 | 879 |
| Marathon | 5 | 277 | 659 | 2 | 53 | 150 |
| Marinette | 1 | 42 | 62 | 5 | 157 | 262 |
| Marquette | 2 | 70 | 140 | -- | -- | -- |
| Oconto | 4 | 216 | 348 | 5 | 219 | 459 |
| Oneida | 8 | 199 | 448 | 8 | 266 | 604 |
| Outagamie | -- | -- | -- | 1 | 6 | 9 |
| Ozaukee | 5 | 189 | 364 | 6 | 147 | 283 |
| Pepin | 2 | 29 | 40 | 1 | 22 | 22 |
| Pierce | 1 | 82 | 178 | 2 | 150 | 150 |
| Polk | 5 | 93 | 135 | 6 | W | W |
| Portage | 4 | 898 | 1,405 | 4 | 647 | 949 |
| Price | 4 | 19 | 42 | 4 | 29 | 29 |
| Racine | 5 | 564 | 871 | 4 | 163 | 415 |
| Richland | 1 | 12 | 12 | 2 | 56 | 237 |
| Rock | 5 | 676 | 1,423 | 7 | 643 | 1,394 |
| Rusk | 5 | 276 | 388 | 3 | 140 | 251 |
| St. Croix | 4 | 175 | 370 | 3 | 83 | 174 |
| Sauk | 3 | W | W | 10 | 354 | 1,120 |
| Shawano | 3 | 206 | 567 | 2 | W | W |
| Sheboygan | 8 | 336 | 601 | 3 | W | W |
| Taylor | 14 | 502 | 684 | 14 | 503 | 1,157 |
| Vilas | 5 | 77 | 138 | 3 | 137 | 231 |
| Walworth | 5 | 464 | 872 | 12 | 724 | 1,563 |
| Washington | 6 | 811 | 1,487 | 7 | 1,203 | 2,221 |
| Waukesha | 21 | 2,816 | 6,053 | 22 | 4,000 | 8,194 |
| Waupaca | 10 | 221 | 609 | 11 | 229 | 575 |
| Waushara | 1 | W | W | 3 | 133 | 315 |
| Undistributed[1] | 18 | 2,079 | 4,660 | 8 | 2,258 | 5,527 |
| Total[2] | 272 | 14,515 | 29,218 | 304 | 17,785 | 38,245 |

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Iron, Sawyer, Washburn, and Winnebago Counties, sand and gravel that cannot be assigned to specific counties (1982), and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

*Industrial.*—Three companies produced sand for industrial purposes in seven counties. Production increased markedly during 1984 as the economy improved. Average value per short ton decreased 4%. Major sales of industrial sand were for foundry applications, glass manufacturing, hydraulic fracturing, and sandblasting.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

**Sulfur (Recovered).**—Murphy Oil Corp. continued to recover byproduct sulfur at its oil refinery in Superior. About 1,800 metric tons was recovered during 1984, roughly 200 tons less than was recovered in 1983.

**Vermiculite (Exfoliated).**—Koos Inc. exfoliated crude vermiculite from out-of-State sources at a plant in Kenosha. Major sales of the product were for agricultural purposes. Lesser quantities were used for loose-fill and packing insulation and concrete and roofing aggregates. Sales volume was essentially unchanged from that of 1983.

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[2] Associate professor, Minerals Information, Wisconsin Geological and Natural History Survey, Madison, WI.

[3] Editorial assistant, Bureau of Mines, Minneapolis, MN.

[4] Wisconsin Department of Transportation, Division of Highways and Transportation Facilities. Construction Section Annual Report—1984. 12 pp.

[5] Harkin, D. A. Mineral Transactions Activity and Terms in Wisconsin—1984. Univ. WI, Agri. Econ. Staff Paper No. 233, 1985, 9 pp.

[6] Seaway Port Authority of Duluth. Port of Duluth-Superior Marine Tonnage. Rep. No. 9, Dec. 1984 final, 6 pp.

[7] La Berge, G. L., and P. E. Myers. Precambrian Geology of Marathon County, Wisconsin. WI Geol. and Nat. History Surv., IC 45, May 1984, 88 pp.

[8] Pit & Quarry. Western Lime & Cement Starts New Chapter in Its Growth Record. V. 88, No. 5, May 1985, pp. 41-43.

## Table 8.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Abrasive stone: | | | |
| Baraboo Quartzite Co. Inc | Box 123<br>Baraboo, WI 53913 | Quarry and plant | Sauk. |
| Cement: | | | |
| National Gypsum Co., Huron Cement Div. | 4000 Town Center<br>Suite 2000<br>Southfield, MI 48075 | Grinding plant | Douglas. |
| St. Marys Wisconsin Cement Inc., a subsidiary of St. Marys Cement Ltd. | 2200 Yonge St.<br>Toronto, Ontario M4S 2C6<br>Canada | do | Milwaukee. |
| Iron oxide pigments (finished): | | | |
| DCS Color & Supply Co. Inc | 2011 South Allis St.<br>Milwaukee, WI 53207 | Plant | Do. |
| Lime: | | | |
| CLM Corp | 12th Ave. West and Waterfront St.<br>Duluth, MN 55802 | do | Douglas. |
| Rockwell Lime Co | Route 2, Box 124<br>Manitowoc, WI 54220 | do | Manitowoc. |
| Western Lime & Cement Co | Box 57<br>West Bend, WI 53095 | Plants | Brown, Dodge, Fond du Lac. |
| Peat: | | | |
| Bogda's Top Soil & Excavating Co. | 12600 West Cleveland Ave.<br>New Berlin, WI 53151 | Bog and plant | Waukesha. |
| Certified Peat & Sod Inc | 19000 West Lincoln Ave.<br>New Berlin, WI 53151 | do | Do. |
| Demilco Inc., a division of Nitragin Sales Corp. | 3101 West Custer Ave.<br>Milwaukee, WI 53209 | do | Do. |
| Perlite (expanded): | | | |
| Midwest Perlite Co | 4280 Parkway Blvd.<br>Appleton, WI 54911 | Plant | Outagamie. |
| Sand and gravel: | | | |
| Construction: | | | |
| American Materials Corp | Box 388<br>Eau Claire, WI 54701 | Pits and plants | Barron, Chippewa, Dunn, Eau Claire. |
| Janesville Sand & Gravel Co., Lycon Inc. | Box 427<br>Janesville, WI 53545 | do | Columbia, Dane, Rock. |
| Johnson Sand & Gravel Inc | N8 W22590 Johnson Dr.<br>Waukesha, WI 53186 | do | Waukesha. |
| Arthur Overgaard Inc | Box 87<br>Elroy, WI 53929 | do | Adams, Columbia, Jackson, Washburn. |
| Valley Sand & Gravel Corp | S63 W197 Luckow Dr.<br>Muskego, WI 53150 | Pit and plant | Waukesha. |
| Wissota Sand & Gravel Co | Box 1268<br>Eau Claire, WI 54702 | Pits and plants | Barron, Rusk, Washington. |
| Industrial: | | | |
| Badger Mining Corp | Box 97<br>Fairwater, WI 53931 | do | Green Lake, Jackson, Marinette. |
| A. F. Gelhar Co. Inc | Box 209<br>Berlin, WI 54923 | do | Waupaca and Winnebago. |
| Treco Sales Inc | Box 38<br>Bartlesville, OK 74003 | Underground mine and plant. | Pierce. |
| Unimin Corp | 258 Elm St.<br>New Canaan, CT 06840 | Pit and plant | Columbia. |
| Stone (1983): | | | |
| Crushed: | | | |
| Granite: | | | |
| Belanger Granite Co | Route 2<br>Auburndale, WI 54412 | Quarry and plant | Marathon. |
| Carl Wimmer | 2807 Dove Ave.<br>Wausau, WI 54401 | do | Do. |
| Wissota Sand & Gravel Co. | Box 1268<br>Eau Claire, WI 54702 | do | Douglas. |
| Limestone and dolomite: | | | |
| Halquist Stone Co. Inc.[1] | N52 W23564 Lisbon Rd., Box B<br>Sussex, WI 53089 | Quarries and plant | Waukesha. |
| Arthur Overgaard Inc | Box 87<br>Elroy, WI 53929 | Quarries and plants. | Buffalo, Juneau, La Crosse, Monroe. |
| Vulcan Materials Co., Midwest Div. | Box 6<br>Countryside, IL 60525 | do | Milwaukee, Racine, Waukesha, Winnebago. |

See footnotes at end of table.

## Table 8.—Principal producers —Continued

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Stone (1983) —Continued | | | |
| Crushed —Continued | | | |
| Sandstone and quartzite: | | | |
| Foley Bros. Inc | Rock Springs, WI 53961 | Quarry and plant | Sauk. |
| Minnesota Mining & Manufacturing Co. | 3M Center<br>St. Paul, MN 55101 | do | Marathon. |
| Traprock (basalt): | | | |
| GAF Corp | Box 630<br>Pembine, WI 54156 | do | Marinette. |
| TCI Traprock Inc. | Box 176<br>Dresser, WI 54009 | do | Polk. |
| Dimension: | | | |
| Granite: | | | |
| Anderson Bros. & Johnson Co. | Box 26<br>Wausau, WI 54401 | Quarries and plant | Marathon and Marinette. |
| Cold Spring Granite Co | Route 2, Box 416<br>Wausau, WI 54401 | Quarry and plant | Marathon. |
| Lake Wausau Granite Co. | Box 397<br>Wausau, WI 54401 | do | Do. |
| Limestone: | | | |
| Buechel Stone Center Inc | Box 907<br>Fond du Lac, WI 54935 | Quarries and plant | Fond du Lac. |
| Halquist Stone Co. Inc.[2] | N52 W23564 Lisbon Rd., Box B<br>Sussex, WI 53089 | Quarry and plant | Waukesha. |
| Sulfur (recovered): | | | |
| Murphy Oil Corp | Box 2066<br>Superior, WI 54880 | Byproduct sulfur recovery plant. | Douglas. |
| Vermiculite (exfoliated): | | | |
| Koos Inc | 4500 13th Ct.<br>Kenosha, WI 53140 | Plant | Kenosha. |

[1] Also dimension limestone.
[2] Also crushed limestone.

# The Mineral Industry of Wyoming

**This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Wyoming for collecting information on all nonfuel minerals.**

### By Karl E. Starch[1] and Gary B. Glass[2]

The value of nonfuel minerals produced in Wyoming in 1984 was $549 million, down 13% from the 1983 value, for the third consecutive year of decline. The drop in overall value of nonfuel minerals produced can be traced to the cessation of iron ore mining in Wyoming, 1983's third most valuable nonfuel mineral, and to a decline in value of sodium carbonate output. Other minerals declining in value were gypsum and crushed stone. Clays (bentonite), construction sand and gravel, and portland cement rose in value over the 1983 figures. Sodium carbonate, or soda ash, was the leading nonfuel mineral in terms of value, accounting for more than three-fourths of the total, according to the State Inspector of Mines data. Bentonite was second in importance, with about 12% of the total, portland cement third, and construction sand and gravel fourth.

**Table 1.—Nonfuel mineral production in Wyoming[1]**

| Mineral | 1983 | | 1984 | |
|---|---|---|---|---|
| | Quantity | Value (thousands) | Quantity | Value (thousands) |
| Clays thousand short tons | 2,140 | $49,059 | 2,397 | $67,290 |
| Gem stones | NA | 250 | NA | 225 |
| Gypsum thousand short tons | 382 | 2,963 | 376 | 2,618 |
| Sand and gravel (construction) do | [e]2,400 | 8,000 | 4,586 | 13,372 |
| Stone (crushed) do | 2,019 | 7,769 | [e]1,900 | [e]7,600 |
| Combined value of beryllium concentrate (1983), cement (portland), iron ore (1983), lime, and sodium carbonate | XX | 561,860 | XX | 458,187 |
| Total | XX | 629,901 | XX | 549,292 |

[e]Estimated. NA Not available. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## Table 2.—Value of nonfuel mineral production in Wyoming, by county[1]

(Thousands)

| County | 1982 | 1983 | Minerals produced in 1983 in order of value |
|---|---|---|---|
| Albany | $12,632 | W | Cement (portland), clays, stone (crushed), gypsum. |
| Big Horn | 29,191 | $19,185 | Clays, gypsum, lime. |
| Campbell | W | (2) | |
| Carbon | W | (2) | |
| Converse | W | (2) | |
| Crook | W | W | Clays, stone (crushed). |
| Fremont | W | W | Iron ore, beryllium. |
| Goshen | W | 361 | Lime. |
| Johnson | W | W | Clays. |
| Laramie | W | W | Stone (crushed). |
| Lincoln | W | 1 | Do. |
| Natrona | 2,620 | 339 | Clays. |
| Park | 1,808 | W | Gypsum. |
| Platte | 222 | W | Stone (crushed). |
| Sheridan | W | (2) | |
| Sublette | W | 40 | Stone (crushed). |
| Sweetwater | W | 514,464 | Sodium carbonate. |
| Teton | W | 13 | Stone (crushed). |
| Uinta | W | W | Clays. |
| Washakie | 2,616 | W | Clays, lime. |
| Weston | W | W | Clays. |
| Undistributed[3] | 611,806 | 87,497 | |
| Sand and gravel (construction) | XX | [e]8,000 | |
| Stone (crushed) | [e]7,300 | XX | |
| Total | 668,195 | [4]629,901 | |

[e]Estimated. W Withheld to avoid disclosing company proprietary data; included with "Undistributed." XX Not applicable.

[1] No production of nonfuel mineral commodities was reported for counties not listed.

[2] Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[4] Data do not add to total shown because of independent rounding.

## Table 3.—Indicators of Wyoming business activity

| | | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|---|
| Employment and labor force, annual average: | | | | |
| Population | thousands | 509 | 516 | 511 |
| Total civilian labor force | do. | 256 | 263 | 254 |
| Unemployment | do. | 15 | 22 | 16 |
| Employment (nonagricultural): | | | | |
| Mining total[1] | do. | 34.6 | 28.5 | 27.2 |
| Metal mining | do. | 2.7 | 2.1 | NA |
| Nonmetallic minerals except fuels[2] | do. | 5.1 | 4.4 | NA |
| Coal mining[2] | do. | 5.8 | 5.6 | NA |
| Oil and gas extraction[2] | do. | 20.8 | 16.3 | NA |
| Manufacturing total | do. | 9.1 | 8.2 | 8.3 |
| Primary metal industries[2] | do. | (3) | 1 | NA |
| Stone, clay, and glass products[2] | do. | 1.1 | 1.1 | NA |
| Chemicals and allied products[2] | do. | .4 | .3 | NA |
| Petroleum and coal products | do. | 1.6 | 1.3 | 1.1 |
| Construction | do. | 20.0 | 14.1 | 13.0 |
| Transportation and public utilities | do. | 17.8 | 16.3 | 15.9 |
| Wholesale and retail trade | do. | 49.0 | 45.9 | 44.7 |
| Finance, insurance, real estate | do. | 7.8 | 7.9 | 8.0 |
| Services | do. | 33.4 | 32.4 | 32.2 |
| Government and government enterprises | do. | 46.0 | 48.9 | 49.7 |
| Total[4] | do. | 217.7 | 202.5 | 198.9 |
| Personal income: | | | | |
| Total | millions | $6,133 | $6,005 | $6,252 |
| Per capita | | $12,040 | $11,643 | $12,224 |

See footnotes at end of table.

## Table 3.—Indicators of Wyoming business activity —Continued

| | 1982[r] | 1983 | 1984[p] |
|---|---|---|---|
| Hours and earnings: | | | |
| Total average weekly hours, production workers | 38.2 | 36.9 | 39.8 |
| Mining | 40.4 | 40.6 | 43.0 |
| Total average hourly earnings, production workers | $8.62 | $8.73 | $8.86 |
| Mining | $11.78 | $12.57 | $12.93 |
| Earnings by industry: | | | |
| Farm income millions | $42 | $46 | $16 |
| Nonfarm do. | $4,631 | $4,341 | $4,521 |
| Mining total do. | $1,139 | $956 | $968 |
| Metal mining do. | $80 | $68 | $43 |
| Nonmetallic minerals except fuels do. | $164 | $155 | $150 |
| Coal mining do. | $230 | $238 | $253 |
| Oil and gas extraction do. | $665 | $496 | $523 |
| Manufacturing total do. | $218 | $202 | $203 |
| Primary metal industries do. | $2 | $2 | $7 |
| Stone, clay, and glass products do. | $27 | $28 | $27 |
| Chemicals and allied products do. | $10 | $9 | $10 |
| Petroleum and coal products do. | $69 | $61 | $60 |
| Construction do. | $507 | $349 | $366 |
| Transportation and public utilities do. | $522 | $508 | $526 |
| Wholesale and retail trade do. | $673 | $631 | $652 |
| Finance, insurance, real estate do. | $141 | $156 | $169 |
| Services do. | $535 | $537 | $579 |
| Government and government enterprises do. | $882 | $988 | $1,043 |
| Construction activity: | | | |
| Number of private and public residential units authorized | 2,937 | 2,872 | 1,586 |
| Value of nonresidential construction millions | $122.4 | $79.6 | $84.8 |
| Value of State road contract awards do. | $110.7 | $144.9 | $172.1 |
| Shipments of portland and masonry cement to and within the State thousand short tons | 405 | 382 | 396 |
| Nonfuel mineral production value: | | | |
| Total crude mineral value millions | $668.2 | $629.9 | $549.3 |
| Value per capita | $1,313 | $1,221 | $1,075 |

[p] Preliminary. [r] Revised. NA Not available.

[1] Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.

[2] Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.

[3] Fewer than 50 employees.

[4] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

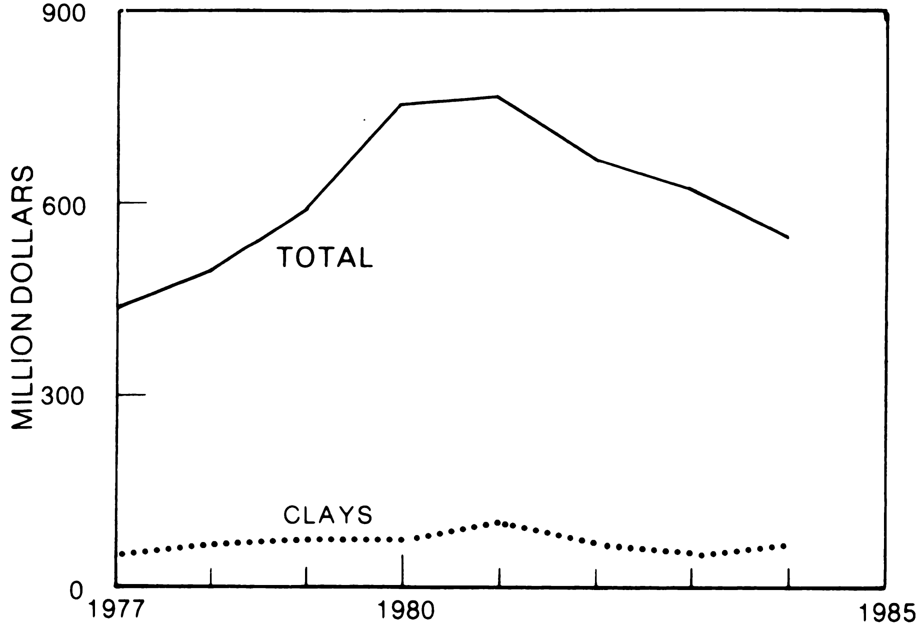

Figure 1.—Value of clays and total value of nonfuel mineral production in Wyoming.

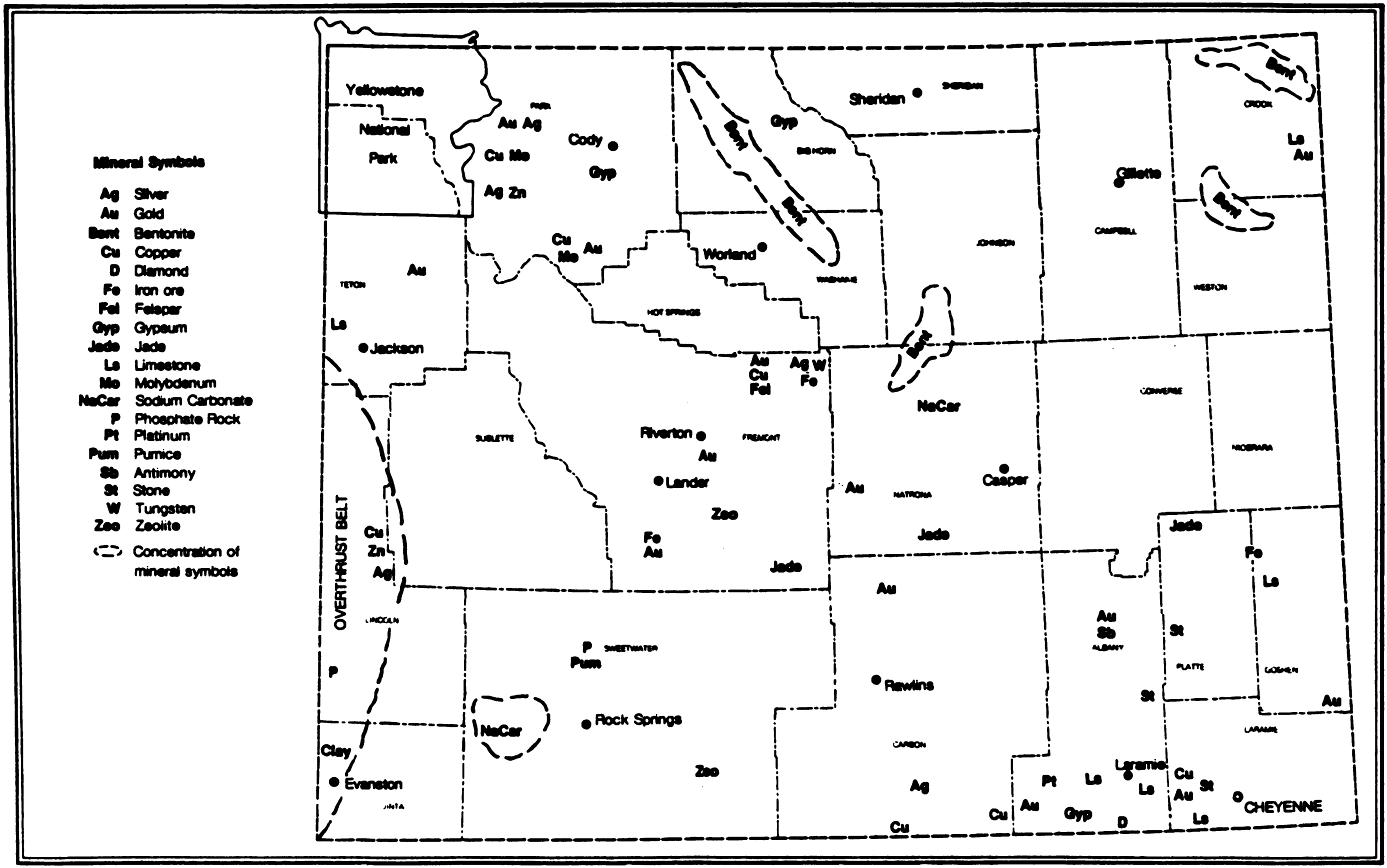

Figure 2.—Principal mineral producing localities in Wyoming.

Eight nonfuel minerals were produced in Wyoming in 1984; all were industrial minerals. Wyoming ranked 14th among nonfuel mineral producing States, three positions lower than its 1983 ranking.

The relative value of nonfuel minerals in Wyoming's economy in 1984 was apparent in its per capita value of nonfuel minerals, $1,075, compared to the national average per capita output of $98.

Major nonfuel mineral events during the year were the permanent closure of the Atlantic City iron ore mine and moderate improvement in output by the State's bentonite industry. The trona industry remained stable.

The mineral industry, mainly fuel minerals, remained by far the largest single contributor to the valuation of the State of Wyoming. Total valuation of mineral production was $5.6 billion, compared with $0.5 billion in 1970. Valuation on trona, largest of the nonfuel minerals, was $104.5 million, up from $10.8 million in 1970. The industry paid the State of Wyoming $373 million in ad valorem taxes, $192 million in severance taxes, and $24 million in sales taxes, with a total of $828 million received from all mineral taxes, rents, and royalties.

In December 1984, average weekly earnings in mining in Wyoming were $588.67, compared with the U.S. average of $514.49. In January 1984, the corresponding figures were $540.93 and $503.14. The average weekly wage for all industries in the State was $348. Employment in mining continued to decline moderately to 26,200 in December 1984, compared with 27,700 in January 1984. Wyoming's State Department of Labor and Statistics figures indicated that employment in trona mining fell 7.3% between 1980 and the end of 1984, bentonite mining employment was down 24.2%, and uranium was down 86.6%. The number of female employees increased from 6.6% of mining employment in 1980 to 7.4% in 1984. Lower unemployment figures in the State in 1984 resulted from unemployed workers leaving the State; there were about 6,300 fewer job seekers in the State at the end of 1984 than at yearend 1983, and about 9,500 fewer people working in the State. Wyoming was the only State without an increase in payroll employment in 1984.

**Exploration Activities.**—Exploration activity was generally low key, compared with a few years ago. Gold West Corp. received tentative approval from the U.S. Forest Service to open a placer gold mine along Cottonwood Creek, 25 miles east of Jackson. Other placer operations continued in the South Pass greenstone belt, and underground exploration at the Carrisa, Mary Ellen, and St. Louis Mines in the same area continued. Freeport Exploration Co. continued its exploration of the historic Miner's Delight Mine area. Limited exploration activity was reported by Exxon Minerals Co. in the Ferris-Haggerty area in the Sierra Madre Range of Carbon County. The property is believed to be a stratiform quartzite-hosted copper-gold-silver deposit, possibly analogous to the Troy, MT, deposit.

Timberline Minerals Inc. core-drilled its Penn gold mine property. Exploration for diamondiferous kimberlite continued. Copper Mountain, north of Shoshoni, received some interest from exploration companies. Exploration for silica deposits continued in southern Wyoming. Kerr-McGee Corp.'s exploration department concentrated its efforts on the search for precious metals, mostly in the Bradley Peak area of the Seminoe Mountains greenstone belt. Some gold prospecting also took place in the Clarks Fork placer area of the northern Wind River Range, in the Bighorn Mountains, in the Bear Lodge and Minerals Hills districts of the Black Hills, and in the Platte district of the Medicine Bow Mountains.

**Legislation and Government Programs.**—No legislation specifically related to the nonfuel mineral industry was enacted by the State legislature during 1984.

The furthest reaching wilderness bill in Wyoming history added 884,049 acres of national forest to the wilderness system, bringing designated wilderness in Wyoming to 3 million acres, one-third of all national forest lands in the State. The bill included a provision to protect State water rights and potential water projects.

The State began plans for reclamation of 32 abandoned coal, copper, feldspar, gold, tungsten, and uranium mines in the South Pass area of Fremont and Natrona Counties; reclamation was estimated to cost approximately $300,000. The State's abandoned mine reclamation program, financed through the Federal Office of Surface Mining, could eventually cost $250 million. About 250 to 300 minesites in the State were identified as requiring reclamation. Opposition came from claim holders wanting to keep gold mines accessible for future development and from those wanting to preserve the historic value of some old mines. About $30 million was allocated to reclaim about 100 bentonite mines in Crook County.

The Geological Survey of Wyoming continued its field investigation and publication programs. Among the investigations on nonfuel minerals completed or continuing in 1984 were a study of the geology and mineral occurrence of the Copper Mountain area of Fremont and Hot Springs Counties and extensive studies of diamondiferous kimberlites in the State. Sampling for heavy minerals in the southern Laramie Range continued. The greatest activity of the Survey was centered in the Happy Jack-Pole Mountain region east of Laramie. More than 30 anomalous samples were collected in the region, and one "diatreme-like" structure was identified. The Survey also collected samples from lamproites in the Leucile Hills, southwestern Wyoming, to test for the possibilities of diamonds.

A regional study on the geology and mineralization of South Pass was begun. When completed, the project will consist of seven 1:24,000-scale geologic quadrangle maps, a regional 1:100,000-scale map of the entire South Pass greenstone belt, and a summary of mineral resources with an emphasis on gold genesis.

## REVIEW BY NONFUEL MINERAL COMMODITIES

### NONMETALS

**Cement.**—Although 1984 was a disappointing year financially to Wyoming's only cement producer, Monolith Portland Cement Co., shipments from its plant south of Laramie increased about 8% over the 1983 level. Stocks of material on hand were reduced considerably. Only portland cement was produced, mostly general use and moderate heat Types I and II, plus a small amount of oil-well cement used in casing and capping oil wells.

Nearly three-fourths of the product was sold to ready-mixed concrete companies; most of the balance went to other contractors. Nearly all was shipped in bulk, mostly by truck directly to the consumer, but some by rail to a distribution terminal.

Clinker production at the plant was restricted during the year when water flooded the plant's crushing facilities and railroad line. Problems with new equipment also arose. These problems were resolved by constructing a new private haul road and acquiring a mobile crusher that permitted raw material crushing at the quarries prior to delivery to the plant. In the future, shale crushing will be done in dry summer months and limestone crushing in the winter.

The new kiln and mills were shut down for an extended period at yearend for repairs and adjustments. A 24% reduction in wages was instituted August 1 as part of an effort to reduce production costs. A disadvantageous coal contract dating from 1981 contributed to the company's continuing cash-flow problems. About 130 people were employed at the plant in 1984. The company was looking for a buyer for the plant.

**Clays.**—The output of clay increased 12% and its value rose 37% over that of 1983. More than 90% of Wyoming's clay production was bentonite clay, and Wyoming remained first of the 15 States that produced bentonite, with nearly 70% of the national total. Although showing some improvement over the preceding year, Wyoming's bentonite industry continued to operate well below capacity.

Seven companies reported bentonite production at 87 pits in 6 counties. The Baroid Div. of NL Industries Inc., Kaycee Bentonite Corp., and American Colloid Co. were the largest producers, accounting for more than 50% of the total. Wyo-Ben Inc. and Federal Ore and Chemicals Inc. (formerly Federal Bentonite, a division of Aurora Industries Inc.) were next in size, followed by International Minerals & Chemical Corp. and Dresser Industries Inc.'s Greybull Div. Nearly one-half of Wyoming's production was from Crook County, and about one-third was from Big Horn County. Average value of bentonite produced in the year was $30.25 per short ton. The bentonite industry, which had employed 1,200 people in 1981, employed about 760 people in 1984.

Wyoming bentonite, a sodium bentonite formed by the alteration of volcanic ash, has swelling characteristics that increase its volume as much as 15 times when wet. Wyoming bentonite occurs in the Bighorn Basin, in the southern Powder River Basin, and along the northern and western edge of the Black Hills in the northwestern corner of the State.

Generally, the companies operating in the Bighorn Basin (Big Horn and Washakie Counties) were Dresser Minerals, the Baroid Div. of NL Industries, Wyo-Ben, American Colloid, and Kaycee Bentonite; in the Powder River Basin (Johnson and Natrona Counties), Kaycee Bentonite; and along the northern and western edge of the Black Hills (Crook and Weston Counties), the Baroid Div. of NL Industries, Federal Ore and Chemicals, International Minerals & Chemical, and American Colloid.

About 52% of bentonite produced was used in drilling mud, 17% in foundry sand, and 14% in pelletizing iron. Other uses included adhesives, animal feed, insulation, paint, paper coating and filling, pharmaceuticals, plastics, and waterproof seals.

Despite the increase in production over that of 1983, 1984 output was 38% less than that of 1981, and the bentonite industry continued to face a contracted market owing to reduced oil well drilling and the slump in the steel industry. Estimates of remaining Wyoming bentonite reserves ranged from 200 million short tons (U.S. Bureau of Mines) to 1,149 million short tons (American Institute of Mining and Metallurgical Engineers). Bentonite was mined only by surface methods; only those deposits with 30 feet or less overburden were considered commercial.

In March, the number of bentonite companies decreased by one as Kaycee Bentonite bought Benton Clay Co. In May, IMCO Services of Houston, a division of Halliburton Co., bought the Federal Bentonite Div. of Aurora Industries, a division of Panhandle Eastern Corp. The sale included three bentonite mines and four processing plants located in Minnesota, Montana, and Wyoming, including the plant at Upton, WY. The facilities had a capacity to produce and process 500,000 tons of bentonite annually.

Three companies produced common clay in Wyoming in 1984, Lone Star Industries Inc. in Albany County, and Interpace Corp. and Interstate Brick Co. in Uinta County. The clay produced in Albany County went into cement products, while the clay produced in Uinta County was used for face brick manufacture.

**Gem Stones.**—Jade (nephrite) was found in several counties, notably in the Granite Mountain area of southern Fremont and southwestern Natrona Counties. The jade industry has been slow for several years.

Cominco American Incorporated continued to explore for diamond-bearing kimberlite in the Colorado-Wyoming State line area. Sampling and testing on the Wyoming State line property indicated grades of 0.005 to 0.01 carat per short ton. Even though gem-quality to industrial-quality diamond ratios were similar to those of many South African kimberlites, the indicated grade was too low for commercial mining, and Cominco terminated its agreement with the Rocky Mountain Energy Co. and the State of Wyoming.

Mobil Oil Co. purchased Superior Oil Co. and began to liquidate Superior Minerals Inc. Superior Minerals had diamond and gold exploration activities in southeastern Wyoming.

**Gypsum.**—Production of crude gypsum remained relatively constant during 1983 and 1984. Three companies reported mining crude gypsum in three counties: Celotex Corp., a subsidiary of Jim Walter Corp., in Park County; Georgia-Pacific Corp.'s Gypsum Div., in Big Horn County; and Wyoming Construction Co. in Albany County. Georgia-Pacific at Lovell and Celotex at Cody, the largest producers, also calcined gypsum. While gypsum from the Bighorn Basin producers was utilized in the manufacture of wallboard for the construction industry, gypsum from Albany County was used in the manufacture of cement.

**Helium.**—Exxon Co. USA continued development of the Riley Ridge area in Sublette County to process 400 million cubic feet per day (MMcfd) of this gas in 1986. The gas contains 0.6% helium, and helium reserves are estimated to be about 103 billion cubic feet. About 90% of the Riley Ridge helium is owned by the Federal Government under the Mineral Lands Leasing Act of 1920. Since the helium will be extracted when the natural gas is produced, the company approached the U.S. Bureau of Mines as to the Government's intentions regarding the helium and was advised that production of the natural gas can proceed with the helium either being vented or utilized by private industry in return for a fee or royalty to the Federal Government. The company indicated that it intends to extract the helium from the gas and inquired of the Bureau of Mines regarding royalty sale of the Federal helium that is produced and sold. Exxon's first-phase development involves drilling 22 gas wells, constructing the gas treatment plant, and installing a gathering system, product pipelines, and a railroad spur to provide transportation for gas and products. The volume of helium expected to be produced under phase 1 is 2.4 MMcfd, or 800 million cubic feet per year. This production can provide additional helium to satisfy commercial demand.

**Lime.**—Quicklime was produced by two companies in four counties in 1984: The Great Western Sugar Co. in Big Horn and Laramie County, and Holly Sugar Corp. in Goshen and Washakie Counties. Output declined by about 22%. Quicklime was used in processing sugar beets. Declining consumption of sugar in the United States damaged the sugar beet industry. In December, Hunt International Resources Corp. of Dallas, parent company of Great Western, announced that all of its sugar beet processing facilities were for sale.

**Perlite (Expanded).**—Only Western Perlite Corp., one of the two perlite expanding plants west of Green River, reported production in 1984. Western Perlite operated intermittently through the year, utilizing raw materials from Idaho; however, Harborlite Corp. was also believed to have operated its plant in the Green River area during the year. Expanded perlite was used as a filter aid.

**Phosphate Rock.**—No phosphate rock was reported mined in Wyoming in 1984. Stauffer Chemical Co. continued to process phosphate mined in Idaho at its Leefe operation in Lincoln County. Phosphate mined in Utah will be brought to Chevron U.S.A. Inc.'s phosphate fertilizer plant south of Rock Springs for processing with sulfur from Wyoming gas-processing plants when that plant becomes operational.

Two Standard Oil Co. of California subsidiaries, Chevron Chemical Co. and Chevron Resources Co., received a permit to begin construction on a $250 million, 400,000-short-ton-per-year ammonium phosphate fertilizer plant south of Rock Springs. The project would include expansion of a phosphate rock mine and beneficiation plant at Vernal, UT, to more than 1 million tons per year; construction of a 95-mile-long, 10-inch slurry pipeline to ship the phosphate over the Uinta Mountains to Rock Springs; and utilization of sulfur produced at Chevron's Carter Creek gas processing plant in Uinta County. The project is expected to provide 700 to 1,000 jobs during peak construction and 220 permanent jobs when completed in 1986. Badger Engineers Inc., a Raytheon company, received a contract to design and build the plant, and Bechtel Petroleum Inc. received the contract for the slurry pipeline system.

**Sand and Gravel (Construction).**—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

Construction sand and gravel was produced in 22 of Wyoming's 23 counties. Sand and gravel output in 1984 was 91% more than the estimated 1983 production and 36% above that of 1982, the last canvassed year. Value of output increased 67% over that of 1983. Fifty-five companies and a city highway department produced the State's sand and gravel from 82 pits. Of the 55 companies producing sand and gravel in the State, Big Horn Construction Co. was by far the largest producer, followed by Casper Concrete Co., Teton Construction Co., and Rocky Mountain Energy. Also among the larger producers were Althoff Construction and Sanitation Co., Gilpatrick Construction Co. Inc., Boatright Smith Co., Rissler-McMurry Co. Inc., and Koppers Co. Inc. These nine companies were the source of just over 50% of the sand and gravel produced in 1984. The 26 smallest producers accounted for 10% of the total.

The major producing counties were Fremont, Natrona, and Laramie, followed by Uinta, Sweetwater, and Lincoln. The six leading counties produced 64% of the State's total. The nine counties at the bottom of the list produced less than 10% of the total. The average unit value was $2.92 per short ton, and values ranged from $1.00 per ton to $9.68 per ton. About 560 people were engaged in sand and gravel production.

About 25% of Wyoming's sand and gravel was used as road base and coverings, 17% in concrete aggregate, 15% in asphaltic concrete, and the balance for fill, railroad ballast, plaster and gunite sands, concrete products, snow and ice control, and other unspecified uses.

The U.S. Bureau of Land Management (BLM) implemented guidelines to prevent unlawful removal of sand and gravel from the 18 million acres in Wyoming affected by a 1983 Supreme Court ruling. That ruling stated that sand and gravel was a mineral reserved to the Federal Government on those lands transferred to private ownership under the 1916 Stock Raising Homestead Act.

### Table 4.—Wyoming: Construction sand and gravel sold or used in 1984, by major use category

| Use | Quantity (thousand short tons) | Value (thousands) | Value per ton |
|---|---|---|---|
| Concrete aggregate | 790 | $3,340 | $4.23 |
| Plaster and gunite sands | 39 | 376 | 9.68 |
| Concrete products | W | W | 2.56 |
| Asphaltic concrete | 697 | 2,178 | 3.13 |
| Road base and coverings[1] | 1,154 | 3,221 | 2.79 |
| Fill | 138 | 242 | 1.75 |
| Snow and ice control | 10 | 25 | 2.50 |
| Railroad ballast | W | W | 1.00 |
| Other[2] | 1,758 | 3,991 | 2.27 |
| Total or average | 4,586 | [3]13,372 | 2.92 |

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1] Includes road and other stabilization (cement).
[2] Includes other unspecified uses and uses indicated by symbol W.
[3] Data do not add to total shown because of independent rounding.

**Sodium Carbonate.**—Wyoming remained first of the two States reporting production of sodium carbonate, or soda ash, from trona and brines in 1984. According to the State Inspector of Mines, the State produced about 75% of the U.S. total soda ash (including synthetic soda ash). Soda ash also accounted for about three-fourths of the State's value of nonfuel mineral output. The level of output was little changed from that of 1983, and the price remained relatively constant at about $67 per short ton. Employment in the Wyoming soda ash industry declined by about 161 people during the year to about 3,150.

Since about 1981, the soda ash industry had been subject to a declining market, along with expanding productive capacity. The market suffered from the increasing substitution of cardboard, metal, and plastic cans for glass containers. The market for flat glass, however, improved with increased automobile manufacture and building construction, but not enough to offset the declining glass container market. Historically, about 50% of soda ash production was consumed in glass manufacture. The industry operated at about 75% of capacity; about 2.8 million tons of productive capacity was idle.

Five companies mined trona-soda ash in Wyoming; all operated within about 25 miles of Green River in Sweetwater County. All companies mined the same 1,300-square-mile trona deposit, estimated to contain as much as 81.7 billion tons of trona and 52.7 billion tons of mixed trona and halite in 42 separate beds. The largest of the five was FMC Corp., which, according to the State Inspector of Mines annual report, produced about 2 million short tons of soda ash in 1984. Others were Allied Chemical Corp., 1.6 million tons; Stauffer Chemical, 1.3 million tons; Texasgulf Inc., 0.8 million tons; and Tenneco Minerals Co., 0.7 million tons. Virtually all soda ash produced is shipped and consumed outside Wyoming. Most of it is shipped in bulk railroad gondolas and consumed east of the Mississippi River.

FMC received a permit from the Wyoming Environmental Quality Council for commencing extraction of trona by solution mining, expanding on earlier permits to experiment with solution mining of trona. The FMC solution mine was in the deeper (2,300 feet), thicker trona beds situated 16 miles south of FMC's existing trona mine and processing plant. The company anticipated that solution mining would not replace more than 10% to 15% of the company's mechanically mined ore from its underground mine. Two other companies were also experimenting with solution mining.

All five soda ash companies in Wyoming were members of the newly formed American Natural Soda Ash Corp., which was organized to expand overseas markets. Exports were slightly higher in 1984 compared with those in 1983, while domestic sales were virtually flat.

Only two of Wyoming's trona-soda ash operations were unionized—FMC and Allied Chemical. A strike at Allied was averted when the existing contract expired in July. FMC's contract expired and was renegotiated without incident in November.

In an effort to assist the industry, one of Wyoming's U.S. Senators introduced a bill into Congress that would place a 20% tariff on sodium bicarbonate baking soda imports. Imports of baking soda, mostly from Mexico and the Federal Republic of Germany, in order of volume, increased fivefold in the past 2 years. No action had been taken by yearend.

**Stone.**—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Only crushed stone was produced in Wyoming in 1984. It was estimated that the amount produced was slightly less than in 1983.

**Sulfur (Recovered).**—Wyoming was third of 26 States reporting recovery of elemental sulfur, producing 12% of the national total. Wyoming's output came entirely as a byproduct of processing natural gas. Natural gas was "sweetened," resulting in byproduct sulfur output in six counties. More than 90% of the total sulfur output was derived from Amoco Production Co. and Chevron U.S.A.'s two large processing plants in Uinta County. These plants were opened in 1982 to process natural gas from fields in the Overthrust Belt of western Wyoming. The other producers were Sinclair Oil Corp. in Carbon County, Amoco in Fremont and Park Counties, Husky Oil Co. in Laramie County, and Colorado Interstate Gas Co. in Sweetwater County.

In November, the Wyoming Environmental Quality Council reaffirmed its decision to grant a permit to Exxon to construct the State's third large natural gas processing plant (Shute Creek) near Kemmerer in Lincoln County.

## METALS

**Gold.**—Although no gold was reported mined in Wyoming in 1984, a small flurry of staking activity occurred in June when the BLM opened 2,000 acres that had been withdrawn from mineral entry since 1967. Freeport Exploration appeared to be the largest company taking an interest in the land, which was in the South Pass area. Geologists from several major companies have been exploring the South Pass-Atlantic City mining district, but Freeport Exploration appeared to have acquired much of the area's most promising land. No discoveries were reported. Several small placers were reported to be active.

**Iron Ore.**—For the first time in this century, no iron ore was mined in Wyoming. Production of iron ore in the State ceased April 1, 1984, when United States Steel Corp. permanently closed its Atlantic City iron ore mine near Lander in Fremont County. The mine, which had been supplying ore to U.S. Steel's Geneva Works near Provo, UT, since 1962, had temporarily suspended operations on October 1, 1983, when U.S. Steel determined it was no longer economical to operate. More than 500 workers were laid off. An estimated 10 to 12 years of iron ore reserves, one-third of the original reserves, were estimated to remain in the mine. More than 90 million short tons of crude iron ore was produced during the lifetime of the mine. Mineral rights to the ore body were owned by J. R. Simplot Co. of Boise, ID.

When U.S. Steel failed to find a buyer for the mine, the Wyoming Department of Environmental Quality told the company it had to begin reclamation of the mine by September 1. The mine had produced about 1.5 million short tons of iron ore pellets annually.

At yearend, Universal Equipment Co. was negotiating with U.S. Steel to purchase the Atlantic City Mine. Among alternatives being considered by Universal were an onsite steel minimill, use of mine spoil for roadbed construction, a gold-processing operation, or sale of the equipment.

In August, a 3-day auction of mining equipment, machinery, and other remnants appeared to end any hopes that Wyoming's other iron ore mine, the Sunrise Mine at Guernsey, Platte County, would ever be reopened. The mine, which had produced as much as 500,000 tons of hematite iron ore annually for CF&I Steel Corp.'s Pueblo, CO, steel mill since the turn of the century, had been closed in July 1980 when high production costs and a slump in the Nation's steel industry made it uneconomic. About 265 jobs were lost. The mine, one of the country's last underground iron ore mines, was allowed to flood, and the headframe was dismantled and scrapped.

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[1] State Mineral Officer, Bureau of Mines, Denver, CO.

[2] State geologist and Executive Director, Geological Survey of Wyoming, Laramie, WY.

## Table 5.—Principal producers

| Commodity and company | Address | Type of activity | County |
|---|---|---|---|
| Cement: | | | |
| Monolith Portland Cement Co.[1] | Box 40<br>Laramie, WY 82070 | Plant | Albany. |
| Clays: | | | |
| American Colloid Co | 5100 Suffield Ct.<br>Skokie, IL 60076 | Pits and plants | Big Horn, Crook, Weston. |
| Dresser Minerals, a division of Dresser Industries Inc. | Box 832<br>Greybull, WY 82426 | do | Big Horn. |
| Federal Ore and Chemicals Inc | 117 5th Ave.<br>Belle Fourche, SD 57717 | do | Crook and Weston. |
| International Minerals & Chemical Corp. | Box 460<br>Belle Fourche, SD 57717 | do | Crook. |
| Kaycee Bentonite Corp | Box 1<br>Mills, WY 82644 | do | Johnson, Natrona, Washakie. |
| NL Industries Inc., Baroid Div | Box 1675<br>Houston, TX 77001 | do | Big Horn and Crook. |
| Wyo-Ben Inc | Box 1979<br>Billings, MT 59103 | do | Big Horn and Hot Springs. |
| Gypsum: | | | |
| Celotex Corp | Box 590<br>Cody, WY 82414 | Surface mine and plant. | Park. |
| Georgia-Pacific Corp | 133 Peachtree St., NE.<br>Atlanta, GA 30303 | do | Big Horn. |
| Wyoming Construction Co.[2] | Box 907<br>Laramie, WY 82070 | Surface mine | Albany. |
| Lime: | | | |
| The Great Western Sugar Co.[2] | Box 5308<br>Denver, CO 80217 | Plant | Big Horn. |
| Holly Sugar Corp | Holly Sugar Bldg.<br>Colorado Springs, CO 80902 | Plants | Goshen and Washakie. |
| Sand and gravel: | | | |
| Althoff Construction and Sanitation Co. | Box 2011<br>Cody, WY 82414 | Pit and plant | Park. |
| Big Horn Construction Co | Box 1009<br>Sheridan, WY 82801 | Pits and plants | Campbell, Fremont, Laramie, Lincoln, Sweetwater, Washakie. |
| Boatright Smith Co | Box 1129<br>Casper, WY 82602 | Pit and plant | Natrona. |
| Casper Concrete Co | Box 561<br>Casper, WY 82601 | do | Do. |
| Gilpatrick Construction Co. Inc | Box 973, South Federal Blvd.<br>Riverton, WY 82501 | do | Fremont. |
| Koppers Co. Inc | Box 2187<br>Fort Collins, CO 80521 | Pits and plants | Albany and Fremont. |
| Rissler-McMurry Co. Inc | Box 2499<br>Casper, WY 82602 | do | Natrona and Uinta. |
| Rocky Mountain Energy Co | 1001 Center St., Suite 36<br>Evanston, WY 82930 | Pit and plant | Uinta. |
| Teton Construction Co | Box 3243<br>Cheyenne, WY 82003 | Pit | Laramie. |
| Sodium carbonate: | | | |
| Allied Chemical Corp | Box 551<br>Green River, WY 82935 | Underground mine and plant. | Sweetwater. |
| FMC Corp | Box 872<br>Green River, WY 82935 | do | Do. |
| Stauffer Chemical Co | Box 513<br>Green River, WY 82935 | do | Do. |
| Tenneco Minerals Co | Box 1167<br>Green River, WY 82935 | do | Do. |
| Texasgulf Inc | Box 100<br>Granger, WY 82934 | do | Do. |
| Stone: | | | |
| Guernsey Stone Co | Box 337<br>Guernsey, WY 82214 | Quarry | Platte. |
| Morrison-Knudsen Co. Inc | Box 1028<br>Cheyenne, WY 82001 | do | Laramie. |
| Summit Materials Co | Box 1716<br>Rapid City, SD 57709 | do | Crook. |

[1] Also clays and crushed stone.

[2] Also crushed stone.

*U.S. GOVERNMENT PRINTING OFFICE: 1986-491-457:20152